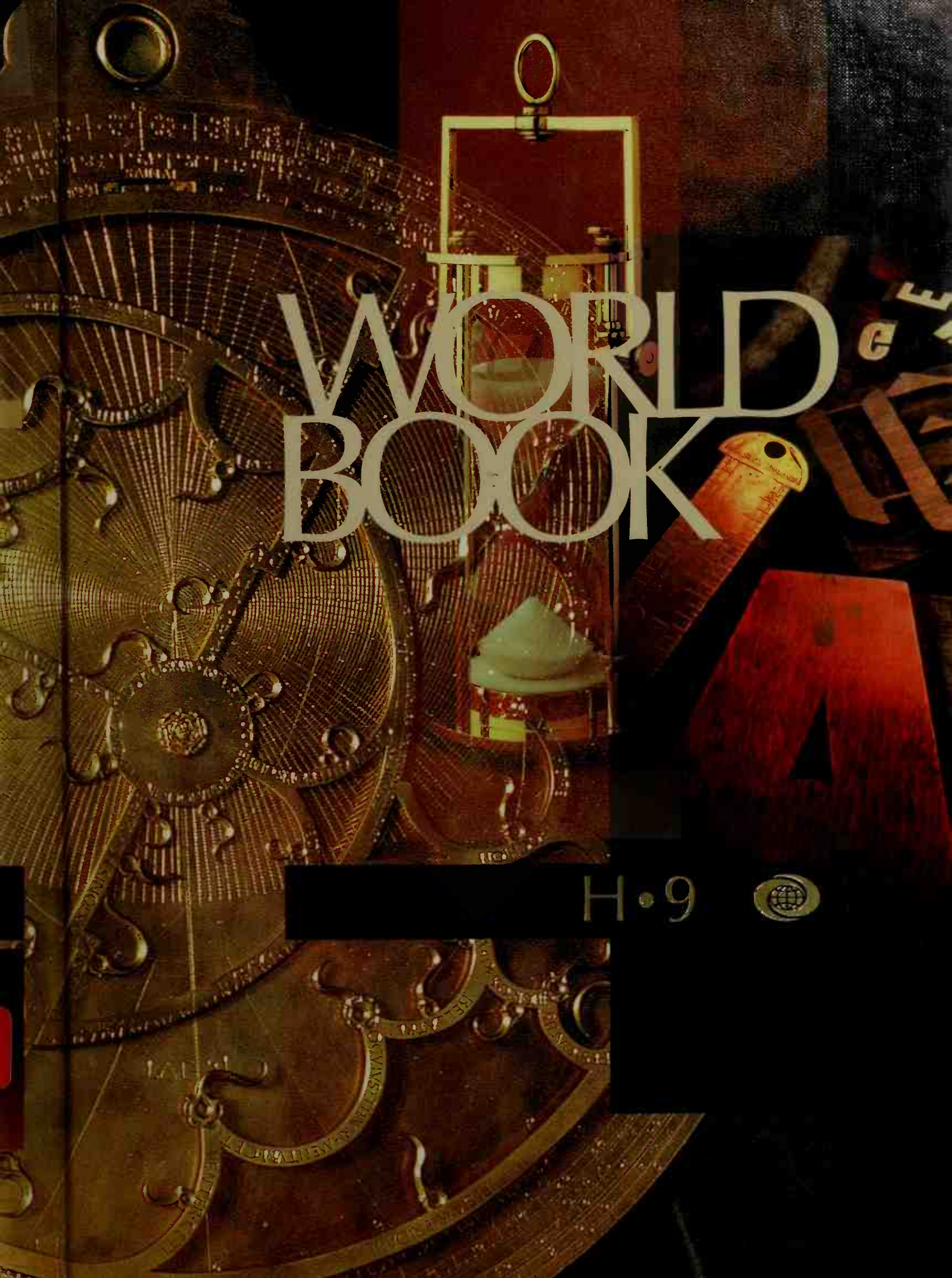
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Hh

H is the eighth letter of our alphabet. It was also a letter in the alphabet used by the Semites, who once lived in Syria and Palestine. The Semites named the letter *cheth,* and adapted an Egyptian *hieroglyphic* (picture symbol) for a twisted hank of rope to represent the letter. The ancient Greeks later took the letter into their alphabet and named it *eta.* They gave it the sound of long *e.* The Romans borrowed the letter from the Greeks, and gave it its final capital form. They also gave it its present sound of *h.* See **Alphabet.**

Uses. *H* or *h* ranks as about the ninth most frequently used letter in books, newspapers, and other printed material in English. In abbreviations, *H* may stand for *Hawaii* and *Hindustan* in geography. *H* also represents *His* or *Her* in the abbreviation *H. M., His* or *Her Majesty.* In chemistry, *H* stands for the element *hydrogen,* and in physics it represents the intensity of the magnetic field. *H* means *henry,* the unit of induction, in electricity. The abbreviation for *harbor* is *h; h.c.l.* means *high cost of living;* and *h.p.* means *horsepower.*

Pronunciation. In English, people pronounce *h* by shaping their lips for the sound of the vowel that follows it. Their vocal cords are apart. In words such as *hail, hat,* and *haste,* a slight impulse of breath normally crosses the vocal cords. But when the *h* sound occurs between two vowels, as in the words *behind* or *ahead,* the *h* sound may be voiced. *H* is silent in words such as *hour* and *honest.* See **Pronunciation.**

Marianne Cooley

Development of the letter H

The ancient Egyptians, about 3000 B.C., wrote a symbol that represented a twisted length of rope.

The Semites modified the Egyptian symbol about 1500 B.C. They called it *cheth.*

The Phoenicians, about 1000 B.C., made the letter with three crossbars.

The Greeks added the letter to their alphabet about 600 B.C. They named the letter *eta.*

H

The Romans borrowed the letter from the Greeks about A.D. 114. They gave the H the shape and sound we use today.

The small letter h first appeared during the A.D. 300's as a rounded letter. By about 1500, the letter had developed its present shape.

A.D. 300 1500 Today

Special ways of expressing the letter H

International Morse Code

Braille

International Flag Code

Semaphore Code

Sign Language Alphabet

Common forms of the letter H

Hh *Hh*

Handwritten letters vary from person to person. *Manuscript* (printed) letters, *left,* have simple curves and straight lines. Cursive letters, *right,* have flowing lines.

Hh *Hh*

Roman letters have small finishing strokes called *serifs* that extend from the main strokes. The type face shown above is Baskerville. The italic form appears at the right.

Hh *Hh*

Sans-serif letters are also called *gothic letters.* They have no serifs. The type face shown above is called Futura. The italic form of Futura appears at the right.

H

Computer letters have special shapes. Computers can "read" these letters either optically or by means of the magnetic ink with which the letters may be printed.

H-bomb. See Nuclear weapon.

Habakkuk, *HAB uh kuhk* or *huh BAK uhk,* **Book of,** is a book of the Old Testament, or Hebrew Bible. The book is named for Habakkuk, an Israelite prophet. A reference to the Chaldeans in the book indicates that Habakkuk lived about 600 B.C.

The Book of Habakkuk is only 56 verses long. It consists of two parts. The prophecies appear in the form of laments and responses in Chapters 1 and 2. Chapter 3 is a hymn. In one of his prophecies, Habakkuk asks why the innocent and good should suffer with the wicked. God answers, "The just shall live by his faith" (Hab. 2:4). Habakkuk closes with a hymn on God's victory over His enemies. Some scholars think the last chapter was composed for use in temple worship. The book formed the basis of an important ancient Biblical commentary found in the Dead Sea Scrolls (see **Dead Sea Scrolls**).

Eric M. Meyers

Habana, La. See Havana.

Habeas corpus, *HAY bee uhs KAWR puhs,* is a legal term which, in its original Latin, means *you are ordered to have the body.* If a person has been arrested or is held by police, a lawyer or friend can obtain a *writ of habeas corpus.* This writ orders the police to produce the arrested person in court. The court then decides if the police have sufficient reason to hold the prisoner or if the prisoner's rights have been violated. Also, in the United States, a federal court may grant a writ of habeas corpus in order to review a person's trial and conviction by a state court.

The writ of habeas corpus is a basic guarantee of personal freedom in English and American law. It prevents unjust or wrongful imprisonment or detention by legal authorities.

In 1679, the Habeas Corpus Amendment Act was passed in England. The act strengthened the use of habeas corpus by stating that the Crown could not detain a prisoner against the wishes of Parliament and the courts. This concept of personal freedom has been carried over into the legal systems of the United States and Canada.

David M. O'Brien

See also **Civil rights** (Due process).

Haber process, *HAH buhr,* is a commercial method of producing ammonia from nitrogen and hydrogen. Fritz Haber, a German chemist, developed the process and demonstrated it in 1909. He patented it in 1910. Another German chemist, Carl Bosch, later adapted the process for industrial use. It is also called the *Haber-Bosch process.*

In the Haber process, three parts of hydrogen unite with one part of nitrogen to form ammonia (NH_3). The process takes place at about 550 °C and at 200 to 250 times atmospheric pressure. The nitrogen and hydrogen combine at the surface of a solid *catalyst,* a substance that speeds up the reaction. It consists mainly of iron, with small amounts of alumina and potassium oxide. All the hydrogen and nitrogen do not combine. The uncombined gases are recirculated through the process.

Almost all modern ammonia plants use the Haber process or variations of it. Most early ammonia plants that used the Haber method obtained hydrogen from *water gas* and nitrogen from *producer gas.* Water gas and producer gas are made from hot coke (see **Gas** [How gas is manufactured]). Today, many ammonia plants obtain hydrogen and nitrogen from other sources. Hydrogen may be obtained from natural gas, and nitrogen may come from the distillation of liquid air (see **Liquid air**). Other modifications of the Haber process include changes in the composition of the catalyst and in the temperature and pressure used.

Kathleen C. Taylor

Habit is something a person learns to do over and over again without thinking about how to do it. Many everyday actions are habits. Imagine how difficult it would be to walk down the street if you had to think of every action needed to take every step. A habit is different from an *instinct.* An instinct is behavior that is inborn, instead of learned (see **Instinct**).

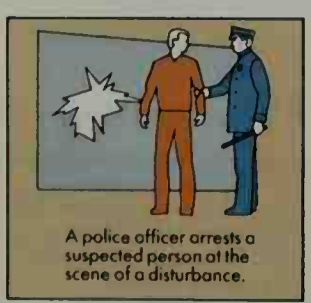
How we learn habits. Most habits begin as actions that a person is aware of. The more the person performs an action, the easier it becomes. Strong habits become automatic, and require little or no thought.

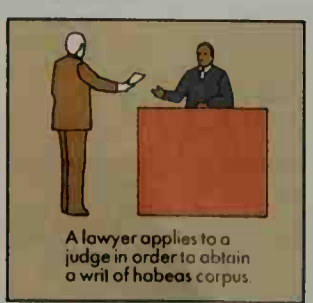
Psychologists generally agree that a *stimulus* (something that starts an action) must be present each time the habit is carried out. A stimulus may be an *internal event,* such as a feeling of loneliness, or an *external event,* such as a red traffic light. In some people, for example, a feeling of loneliness triggers the habit of eating sweets. A red traffic light is a stimulus to an experienced automobile driver. It triggers the habit of pressing the brake pedal. To learn this habit, each new driver must practice under actual traffic conditions, learning to press the brake pedal when the light is red.

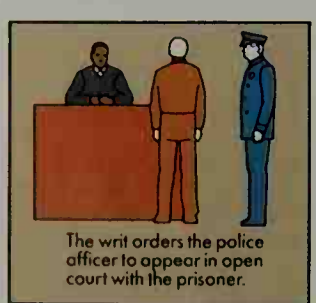
Many psychologists believe that people will learn a habit only if it benefits them. Psychologists call this satisfaction a *reward* or a *reinforcement.* If the habit satisfies people, they tend to keep it. When a habit offers no reward or becomes unpleasant, they may *break* (discard) it. For example, some people get pleasure from smoking. Because of the pleasure (reward), smoking becomes a habit. If the habit becomes unpleasant (no longer brings a reward), a person may stop smoking.

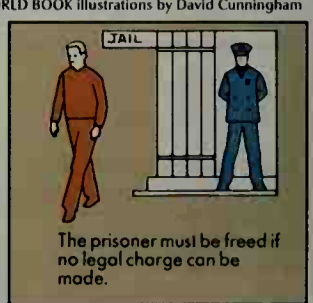
How habeas corpus protects our liberty

WORLD BOOK illustrations by David Cunningham


A police officer arrests a suspected person at the scene of a disturbance.


A lawyer applies to a judge in order to obtain a writ of habeas corpus.


The writ orders the police officer to appear in open court with the prisoner.



The prisoner must be freed if no legal charge can be made.

Psychologists who support the reward idea of habit formation disagree with an older idea. The older idea said that "paths" were made in the nervous system when an act was repeated. However, psychologists have taught rats habits and then cut their nervous systems at many points. Despite the cuts, the rats continued to perform the habits. This result suggests that the learning of habits does not depend on specific nerve connections and does not occur only in particular parts of the brain.

Kinds of habits. Some habits are simple and require only movements of the muscles. When approaching a door, a person grasps the doorknob. This action is called a *simple motor act.* The movement seems quite natural, but the person once had to learn this habit.

Some habits are more than simple motor acts. They are thoughts and attitudes we have about things and people. Psychologists call them *habits of adjustment.* Some of these habits are "good" and others are "bad," depending on how they affect other people. We learn "good" habits to act as others expect us to act. Neat appearance and pleasant manners are considered good habits. A person may learn "bad" habits, thinking something can be gained from them. But such habits may be annoying to others. Leonard M. Horowitz

See also **Learning; Behavior.**

Habitat, *HAB uh tat,* is the kind of place in which a plant or animal usually lives in nature. Water lilies and desert cactus plants have different habitats. The habitat of deep-sea fishes is quite different from that of mountain goats. Various animals and plants can be kept alive outside their natural habitats if given special care in aquariums, zoos, or botanical gardens.

Plants and animals live where they can satisfy their needs. Goldfish and pond plants require fresh water. On the other hand, the barnacles that cling to a ship must live in salt water. In some cases, creatures can adapt themselves to a changing habitat.

A single area may satisfy the needs of many kinds of plants and animals. These organisms that associate together in a common habitat form communities. Communities exist in various places, including (1) on the seashore, (2) in deserts, (3) in freshwater lakes, and (4) in tropical forests. Lawrence C. Wit

See also **Animal** (Where animals live; Destruction of habitat); **Biodiversity; Biome; Ecology; Plant** (Where plants live); **Wetland.**

Habsburg, *HAPS burg,* **House of,** was one of Europe's most famous royal families. The Habsburgs (also spelled *Hapsburg*) ruled the Holy Roman Empire for nearly 400 years. Members of the family occupied thrones in Europe from the 1200's to the early 1900's, except for a few years. The name *Habsburg* comes from one of the family's first castles, the *Habichtsburg* (*Hawk's Castle*), built about 1020 in Switzerland. In 1273, Rudolf became the first member of the family to be elected Holy Roman emperor. Three years later, he conquered Austria, which became the Habsburgs' new home. Beginning in 1438, family members were elected Holy Roman emperor almost without interruption until 1806.

In the late 1400's, Maximilian I greatly increased the family's power by arranging a number of marriages between Habsburgs and members of other royal houses. By 1519, his grandson Charles V had inherited many kingdoms, including Spain and the Spanish empire in America. In 1522, Charles gave Austria to his younger brother Ferdinand. Through marriage, Ferdinand acquired Hungary and Bohemia four years later. Thus, after 1526, the Habsburgs consisted of two branches—a Spanish line headed by Charles's descendants, and an Austrian line descended from Ferdinand.

The Spanish branch lasted until 1700. Charles VI, the last male heir of the Austrian Habsburgs, died in 1740. In 1736, Charles's daughter Maria Theresa married Francis Stephen, Duke of Lorraine. As Francis I, he regained the throne of the Holy Roman Empire for the family in 1745. The descendants of Francis and Maria Theresa were Holy Roman emperors until 1806 and emperors of Austria from 1804 to 1918. Charles W. Ingrao

Related articles in *World Book.* For information on Habsburg rule, see the *History* section in the articles **Austria; Belgium; Czech Republic; Germany; Hungary; Prague; Switzerland;** and **Vienna.** See also:

Charles V (Holy Roman emperor)
Ferdinand II
Ferdinand III
Francis II (Holy Roman emperor)
Francis Joseph
Holy Roman Empire
Maria Theresa
Maximilian I

Hackberry is the name of about 70 species of trees and shrubs found throughout the world. Three important species grow in the United States. The *common hackberry,* also called the *eastern hackberry* or simply *hackberry,* grows throughout the Eastern United States and as far west as Kansas. It may stand more than 120 feet (37 meters) tall but typically grows to a height of 30 to 50 feet (9 to 15 meters). The *sugarberry,* found in the Southeast, measures about 60 to 80 feet (18 to 24 meters) tall. The *netleaf hackberry* is a shrub or small tree. It grows primarily in the Western United States and may reach a height of 30 feet (9 meters).

Hackberries have smooth gray bark, often with corky warts or ridges. Their oval, pointed leaves grow in two rows. Hackberries produce round red or purple berries that ripen in fall and are eaten by squirrels and birds. The wood is yellowish and can be used for furniture.

Richard C. Schlesinger

Scientific classification. Hackberries are in the elm family, Ulmaceae. The common hackberry is *Celtis occidentalis.*

See also **Tree** (picture: Broadleaf trees).

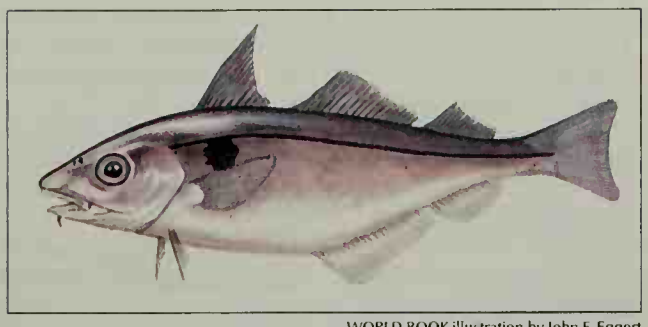
Hackmatack. See **Larch.**

Hadassah, *hah DAH suh,* is an organization of Jewish women in the United States. Its official name is *Hadassah, the Women's Zionist Organization of America, Inc.* In the United States, Hadassah helps strengthen links with Israel; informs members about issues relating to women, democracy, and the Middle East; offers educational programs for members; and sponsors *Young Judaea,* the largest U.S. Zionist youth movement.

Among its projects in Israel, Hadassah supports a medical center in Jerusalem; an institute of technology and a career counseling institute; land reclamation in cooperation with the Jewish National Fund; and *Youth Aliyah,* a youth rescue movement that aids refugee children. *Hadassah International* is a worldwide organization involving people of all religious faiths who support the Hadassah Medical Organization.

Hadassah was founded in New York City in 1912 by social worker Henrietta Szold (see **Szold, Henrietta**). It has about 385,000 members. Headquarters are in New York City. Critically reviewed by Hadassah

Haddock, *HAD uhk,* is an important food fish that belongs to the codfish family. A black line along each of its sides and a black spot just back of its head distinguishes the haddock from other codfish. The front fin on the haddock's back is more pointed than that of other codfish. Haddock live in the western North Atlantic Ocean off New England, Newfoundland, and Nova Scotia. In the eastern North Atlantic, they are found off northern Europe, Britain, and Iceland. They are abundant in the



WORLD BOOK illustration by John F. Eggert

The haddock is an important food fish.

North Sea. Haddock weigh about 3 pounds (1.4 kilograms) and are about 2 feet (60 centimeters) long.

The worldwide commercial catch of haddock is approximately 480,000 tons (435,000 metric tons) each year. Most of the United States catch is taken with large, funnel-shaped nets called *otter trawls.* Haddock are sold fresh and frozen and are made into fillets, fish sticks, and smoked fish products.

Haddock travel in schools and live along the ocean floor. They feed on crabs, shrimp, worms, and small fish.

Robert R. Rofen

Scientific classification. Haddock are in the codfish family, Gadidae. The common haddock is *Melanogrammus aeglefinus.*

Hades, *Hay deez,* was the god of the dead in Greek mythology. He ruled the kingdom of the dead, which had the same name. The ancient Romans preserved without change almost all the myths about Hades and his kingdom, but they called the god Pluto.

Hades was the son of Cronus and Rhea, and the older brother of Zeus, the king of the gods. In spite of Hades's importance to the Greeks, they did not devote any rituals to him. Few myths involve Hades directly.

The kingdom of Hades was a neutral region reserved for the souls of people who deserved neither punishment nor reward upon death. The Greeks believed that Hades was drab and dull, but not necessarily painful. The souls of those who had led virtuous lives dwelled happily in Elysium. The souls of those who had sinned greatly went to Tartarus, a land far below the earth. There, they suffered eternal torment.

The Greeks believed Hades was beneath the earth. It had five rivers—the Acheron, the Kokytos, the Lethe, the Phlegethon, and the Styx. Each served as a boundary between the land of the living and the land of the dead.

The Styx was the best-known river in Hades. To cross it, a soul had to be ferried by Charon, a boatman. He demanded payment, so the Greeks placed coins in the mouths of their dead before burying them. Hades's house stood on the shore of the Styx. Cerberus, a monstrous three-headed dog, guarded the house. After crossing the river, each soul was assigned to its eternal home by 1 of 3 judges—Aeacus, Minos, or Rhadamanthys. Those guilty of serious offenses were tormented by goddesses called *Furies* or *Erinyes.*

C. Scott Littleton

Related articles in *World Book* include:

Cerberus	Hell	Persephone	Sisyphus
Elysium	Lethe	Pluto (god)	Tartarus
Furies			

Hadj. See Hajj.

Hadrian, *Hay dree uhn* (A.D. 76-138), was a Roman emperor. He became known for the personal attention he paid to the provinces of the Roman Empire, nearly all of which he visited while he was emperor. He also began the process of organizing Roman law into a uniform code.

Hadrian undertook many building projects. The Pantheon, completed during his reign, still stands in Rome (see **Pantheon**). Hadrian fortified parts of the frontier and built a stone wall in northern Britain (see **Roman walls**). He founded two new cities—Antinoopolis in Egypt and Hadrianople in Thrace (now Edirne, Turkey). He also completed the huge temple of Zeus in Athens, which had been begun in the 500's B.C.

Hadrian's official name was Publius Aelius Hadrianus. He came from Italica in Spain. His father died during Hadrian's youth, and Trajan, Hadrian's cousin, became his guardian. Trajan became emperor in 98. Hadrian held military and senatorial posts and traveled to the northern and eastern frontiers of the empire. He became emperor after Trajan's death in 117.

Hadrian was a poet, an amateur architect, and a student of Greek culture. His reign was generally peaceful. He rejected Trajan's aggressive policies, ending a war with Parthia, a land beyond Rome's eastern frontiers. To avoid further wars, he returned Parthian territory that Rome had won. The only major conflict occurred in 132, when Jews in Palestine revolted. Hadrian crushed the revolt in 135. He made Jerusalem a Roman colony and forbade Jews to worship there. In 138, Hadrian picked Titus Aurelius Antoninus (Antoninus Pius) to succeed him.

F. G. B. Millar

Hadrian IV, pope. See Adrian IV.

Hadron, *HAD rahn,* is a major group of subatomic particles. Hadrons include both protons and neutrons, which are found in an atom's nucleus. Hadrons are affected by the *strong interaction,* a force holding the nucleus together.

Hadrons consists of smaller particles called *quarks* and *antiquarks.* These particles occur in two combinations, which form the chief types of hadrons—*mesons* and *baryons.* A quark linked to an antiquark makes up a meson. Three quarks combined comprise a baryon. The baryon has an antimatter counterpart called an *antibaryon,* which consists of three antiquarks. See **Antimatter.**

All hadrons except protons and neutrons are extremely unstable. They disintegrate spontaneously in a few hundred millionths of a second or less. For this reason, only protons and neutrons are found in ordinary matter. However, physicists can readily produce unstable hadrons by causing a beam of high-energy particles to collide with matter. They have discovered nearly 300 kinds of hadrons by this means.

All hadrons are nearly the same size, ranging from about 0.7 to 1.7 *femtometers* (quadrillionths of a meter)

in diameter. But hadrons vary widely in mass. The lightest, the *pions,* have only about $\frac{1}{7}$ of an *atomic mass unit* (see **Atom** [Atomic weight]). The heaviest, the *upsilons,* carry more than 10 atomic mass units. Robert H. March

See also **Baryon; Gluon; Meson; Quark.**

Hadrosaur, *HAD ruh sawr,* is the name of a diverse group of dinosaurs with wide snouts resembling duck bills. These animals, also called duckbilled dinosaurs, lived about 65 million to 97 million years ago. Scientists believe hadrosaurs were among the most social of all dinosaurs. The animals probably lived in herds, nested in colonies, and took care of their babies.

Most hadrosaurs grew 25 to 35 feet (7.6 to 11 meters) long and may have weighed 3 to 4 short tons (2.7 to 3.6 metric tons) or more. Newly hatched hadrosaurs were only about 1 foot (30 centimeters) long. Scientists think the animals grew extremely fast, taking only 4 to 5 years to reach adult size. Hadrosaurs probably walked on all four legs most of the time. But when escaping predators, they raised their forelegs and ran on their two hind legs. Hadrosaurs ate several kinds of plants. They had about 250 teeth with which to chew their food.

Many hadrosaurs had elaborate bony crests on top of their heads. Some crests consisted of solid bone. Others were hollow, surrounding air passages. Hollow-crested hadrosaurs could have made honking sounds by exhaling air from their nose through the passages. The crests and the sounds they produced may have helped hadrosaurs attract mates. David B. Weishampel

See also **Dinosaur** (pictures).

Haeckel, *HEHK uhl,* **Ernst Heinrich,** *HYN rihk* (1834-1919), a German zoologist, became known for his theory of *recapitulation.* This theory, no longer held by most zoologists, states that each animal during its growth as an embryo repeats the changes its ancestors underwent. For example, if a land animal had ancestors that lived in water and used gills, then each of its embryos continues to develop gills as did its ancestors, even though the gills may be lost during later embryonic development.

Haeckel studied and made drawings of the embryos of many animals. He also used his findings to support Charles Darwin's theory of evolution (see **Darwin, Charles R.**). Haeckel was the first to draw a "family tree" of animal life, showing the supposed relationships of animal groups. His widely read book, *The Riddle of the Universe* (1899), explained many of his theories. His early work included a study of marine organisms, chiefly radiolarians, coelenterates, and echinoderms.

Haeckel was born in Potsdam. He liked botany, but studied medicine at his father's insistence. He was educated at Würzburg, Vienna, and Berlin universities. He served as a professor of zoology at the University of Jena from 1862 to 1909. Keith R. Benson

Haema or **Haemo.** For words beginning with these syllables, see *hema* or *hemo,* as in **Hemolysis.**

Hafiz, *hah FIHZ* (1325?-1389?), was the pen name of Shamsu'd-din Mohammad, considered the greatest lyric poet in the Persian language. Hafiz's *divan* (collected works) consist almost entirely of short to moderate length lyrical works called *ghazals.* The people of Persia (now Iran) called him "the Tongue of the Unseen" because of the sweetness and beauty of his lyrics. Hafiz was born and died in Shiraz, a city to which he showed great attachment in his poems. Dick Davis

Hafnium, *HAF nee uhm,* a chemical element, is a silver-colored metal. It absorbs neutrons better than most metals and is resistant to corrosion. For these reasons, rods made of hafnium are used to control the rate of reactions in nuclear reactors of nuclear submarines. When the reaction rate is too high, the rods are pushed into the reactor to absorb some of the neutrons. When the rate is low, the rods are withdrawn. Hafnium is also used in some gas-filled and incandescent lamps. The highest concentrations of hafnium occur in the minerals zircon and baddeleyite. Hafnium is always found with the more common element zirconium, which it resembles in its chemical and physical properties.

Hafnium has the chemical symbol Hf. Its atomic number is 72 and its atomic weight is 178.49. It melts at about 2227 °C and boils at 4602 °C. Its specific gravity is 13.31 grams per cubic centimeter. Dirk Coster, a Dutch physicist, and Georg von Hevesy, a Hungarian chemist, discovered hafnium in 1923 in Copenhagen, Denmark. The word *hafnium* comes from *Hafnia,* the Latin name for Copenhagen. R. Craig Taylor

See also **Zirconium.**

Hagåtña, *hah GAHT nyah* (pop. 1,139), is the capital of the American island of Guam. The city was formerly known as Agana. It lies on the island's west coast. For location, see **Guam** (map). The city, which had a 1940 population of about 10,000, was largely destroyed during World War II (1939-1945). After the war, it was rebuilt, but its population never reached its prewar level.

Spain made Guam a possession in 1561 and ceded it to the United States in 1898. Hagåtña has sites that date from the Spanish period. Donald H. Rubinstein

Hagen, *HAY guhn,* **Walter** (1892-1969), was a great golfer and the player most responsible for elevating professional golf into a major sport. Hagen's insistence on first-class treatment at tournaments raised the stature of professional golfers during a time when amateur players dominated the game. His popularity greatly contributed to making golf a spectator sport.

Hagen's skill as a player combined with his showmanship and colorful lifestyle to make him golf's first celebrity. Hagen sometimes arrived for a match in a chauffeur-driven limousine and wearing a tuxedo. He was the first golfer to earn more than a million dollars in tournaments and exhibitions and the first player to market golf equipment bearing his name.

Walter Charles Hagen was born in Rochester, New York. Between 1914 and 1929, he won 11 major tournaments. He won the United States Open in 1914 and 1919; the British Open in 1922, 1924, 1928, and 1929; and the Professional Golfers' Association (PGA) tourney in 1921, 1924, 1925, 1926, and 1927. Marino A. Parascenzo

Hagenbeck, *HAH gehn behk,* **Carl** (1844-1913), organized the type of trained wild animal acts that are presented today. He was born in Hamburg, Germany, and operated a nearby zoo. His father, a fishmonger, made a hobby of collecting and training a few animals. Hagenbeck decided when he was 12 to collect and train animals as a career. One of his first and biggest orders came from the American showman P. T. Barnum.

Hagenbeck traveled to the United States for the first time in 1886. His trained wild animals were a sensation at the World's Columbian Exposition in Chicago in 1893. The spectacle of a lion riding a horse and a tiger riding

an elephant appealed to the public and forward-looking circus people. A group of American showmen operated the Carl Hagenbeck Circus in 1905 and 1906. It became the famous Hagenbeck-Wallace Circus, which performed from 1907 to 1938. But Hagenbeck was never a proprietor of this circus. Robert L. Parkinson

Hagfish is an eellike fish related to the lampreys. Hagfishes live in the sea. Some live in deep water and others in muddy bays. A hagfish has a round mouth surrounded by six short *barbels* (tentacles). Its tongue has sharp, horny teeth. Hagfishes use them to eat the flesh of dead or dying fish. Hagfishes produce large amounts of slime. When disturbed, the *Atlantic hagfish* produces enough slime to fill a bucket in a minute. John J. Poluhowich

Scientific classification. Hagfishes make up the hagfish family, Myxinidae. The Atlantic hagfish is *Myxine glutinosa*.

See also Fish (Lampreys and hagfish; picture: The chief kinds of fish); Lamprey.

Haggai, *HAG ee eye* or *HAG eye,* **Book of,** is a book of the Hebrew Bible, or Old Testament, named for an ancient Jewish prophet. Haggai lived in Jerusalem about 520 B.C. The Jews had just returned from exile in Babylon, and Haggai convinced them to take up the task of rebuilding the holy Temple in Jerusalem. Haggai preached that the rebuilt Temple would signify the return of God's favor to the Jewish people and would bring them better times. He called upon the priests to purify certain religious activities. He addressed Zerubbabel, the Persian-appointed governor of Judah, about a glorious future age when God would destroy foreign kingdoms. Then a king, a descendant of the great King David, would reign. Eric M. Meyers

Haggard, H. Rider (1856-1925), was one of the most successful English writers of popular fiction in the late 1800's. He wrote 58 volumes of fiction, and 7 volumes of economic, political, and social history. Haggard's best novels are based on his experiences in Africa. *King Solomon's Mines* (1885) became a young people's classic. It is the story of a search for the legendary lost treasure of King Solomon. *She* (1887) is the story of Ayesha, a white goddess of Africa who is 2,000 years old but still appears young and beautiful.

Henry Rider Haggard was born in Norfolk. He moved to South Africa in 1875. King George V knighted Haggard in 1912, and he became known as Sir Henry Haggard. David Geherin

Hägglund, Joel. See Hill, Joe.

Hagia Sophia, *HAY ee uh soh FEE uh,* is the most impressive surviving example of Byzantine architecture. Built between A.D. 532 and 537 as the Christian cathedral of Constantinople (now Istanbul, Turkey), Hagia Sophia is famous for its huge central dome and richly decorated interior. The Byzantine emperor Justinian I ordered the cathedral built after a fire had destroyed an earlier church on the site. Hagia Sophia is a Greek phrase that means *holy wisdom.*

The architects of Hagia Sophia, Anthemius of Tralles and Isidorus of Miletus, designed an elaborate framework of arches and *vaults* (arched ceilings) that support the central dome and create a complex interior space. The dome is 102 feet (31 meters) in diameter and rises to 185 feet (56 meters) above the floor. The building measures 250 feet (76 meters) from east to west and 235 feet (72 meters) from north to south.

Multicolored marble veneers and ornamental mosaics originally decorated the interior. Images of religious figures were added in the late 800's. In 1453, the Ottoman Turks converted the cathedral into a *mosque* (Islamic house of worship) and plastered over the images. Since 1935, Hagia Sophia has served as a museum, and mosaics of the Virgin Mary, Jesus Christ, angels, bishops, and rulers have been uncovered.

Annabel Jane Wharton

See also Architecture (Byzantine architecture; picture); Byzantine art; Byzantine Empire (pictures); Istanbul (picture).

Hague, *hayg,* **Frank** (1876-1956), an American politician, served as mayor of Jersey City, New Jersey, from 1917 to 1947. Through his firm control of the Democratic Party in his area, Hague became influential in national politics. He was a key supporter of United States President Franklin D. Roosevelt. This support helped Hague dominate New Jersey politics, despite widespread complaints of political corruption in that state while he was in control. Hague was born in Jersey City. David E. Kyvig

Hague, *hayg,* **The** (pop. 445,279; met. area pop. 695,217), is the seat of the government of the Netherlands and the official residence of the country's monarch. However, Amsterdam is the country's capital. Many important European treaties have been signed at The Hague. The city is officially called 's Gravenhage *(SKRAH vun HAH kuh),* which means *the count's hedge.*

In the early 1900's, the world's eyes hopefully turned toward The Hague. Peace-loving peoples dreamed that it might become the neutral capital of the world, where representatives of all nations could meet to settle quarrels and prevent war. A magnificent Peace Palace was built as a monument to that dream. The Peace Palace serves as headquarters for the Permanent Court of Arbitration and the International Court of Justice.

The Hague lies on the southwest coast of the Netherlands, about 3 miles (5 kilometers) inland from the North Sea (see Netherlands [map]). Adjacent to The Hague on the north is Scheveningen, a fishing town and the largest seaside resort in the Netherlands.

The Hague is a handsome city with many large parks and quiet, treelined streets. Its stately old buildings and elegant residences are reminders that the city was inhabited by aristocrats and government officials rather than by the merchants who dominated other Dutch cities. The Hague has three royal palaces, including *Huis ten Bosch* (House in the Woods), the residence of the country's monarch. At the heart of the old part of the city stand the parliament buildings, called the Binnenhof, and the Mauritshuis, a famous art museum. The Hague has several churches that date from the Middle Ages.

The city's economy depends mainly on the government, the chief employer. The city has little industry, but several large firms have offices or headquarters there.

History. The Hague was originally a hunting lodge belonging to the count of Holland. In 1250, it became the count's residence. When the Netherlands became independent in the 1500's, The Hague became the seat of the States-General, the parliament that governed all the provinces that were united in the new Dutch republic. The Triple Alliance of England, Sweden, and Holland was signed in The Hague in 1668, and the Triple Alliance of England, France, and Holland was signed there in

D. Bartruff, FPG

The Peace Palace was built in The Hague in the early 1900's. It serves as headquarters for the Permanent Court of Arbitration and the International Court of Justice.

1717. At the suggestion of the Russian czar, a peace conference took place in the city in 1899. By then The Hague had become a permanent site for international conferences. In 1907, representatives of European nations met there in an unsuccessful effort to solve the problems that later led to World War I (1914-1918).

The city was occupied by German forces in 1940, during World War II. War damage was extensive. The Germans set up a defense system at Scheveningen and launched V-2 rockets from The Hague. The Allies bombed The Hague 50 times before freeing it from the Germans in 1945. Jan de Vries

Hahn, Otto (1879-1968), was a German chemist who discovered the process of *nuclear fission* (the splitting of the nucleus of an atom) in 1938. Hahn and his associate, Fritz Strassmann, studied the effects of bombarding uranium with *neutrons* (atomic particles). They found that the bombardment changed some of the uranium to barium, an element much lighter than uranium. In 1939, the Austrian-born physicists Lise Meitner and Otto Frisch identified Hahn's experiments as a splitting of the uranium atom. They named the process nuclear fission.

Hahn studied many radioactive substances. Between 1904 and 1907, he discovered new *radioisotopes* (radioactive forms) of the elements thorium and actinium. In 1917, he and Meitner were among the first to isolate the radioactive element protactinium (see **Protactinium**). For his work with radioactive substances, Hahn won the 1944 Nobel Prize in chemistry.

Hahn was born on March 8, 1879, in Frankfurt (am Main), Germany. He received a Ph.D. degree from the University of Marburg in 1901. In 1912, he joined the faculty of the Kaiser Wilhelm Institute for Chemistry (now the Max Planck Institute for Chemistry) in Mainz. He became its director in 1928 and president of the Kaiser Wilhelm Society (now the Max Planck Society) in 1946. He died on July 28, 1968. Martin D. Saltzman

See also **Nuclear energy** (Artificial fission).

Hahnemann, *HAH nuh muhn,* **Samuel** (1755-1843), a German physician, founded the homeopathic method of treating disease. He believed that a drug which produces symptoms in a healthy person will cure those symptoms in a sick person (see **Homeopathy**). Hahnemann published his major work, the *Organon der rationellen Heilkunst (Principles of Rational Medicine),* in 1810. The book contains his chief ideas: to let like cure like, that medicines become more potent as they are diluted and shaken, and that only one remedy should be given at a time.

Hahnemann was born on April 10, 1755, in Meissen, Germany. His full name was Christian Friedrich Samuel Hahnemann. He practiced in many towns in Germany—especially in Leipzig—and later in Paris, where he died on July 2, 1843. Matthew Ramsey

Haida Indians, *HY duh,* live chiefly on the Queen Charlotte Islands of British Columbia in Canada and on Prince of Wales Island of Alaska in the United States. They became famous for their large oceangoing canoes and carved wooden totem poles, masks, and boxes.

In their traditional way of life, the Haida made their living by fishing, gathering wild plants, and hunting. They lived in villages of plank houses along sheltered beaches. Family groups placed totem poles in front of their homes and elsewhere to signify the group's social rank and ancestry. Wealthy families controlled large fishing areas, and some owned slaves. Haida chiefs still sponsor *potlatches,* ceremonial festivals at which hosts give gifts to their guests to mark important occasions and to establish social rank. Today, there are about 3,000 Haida Indians. Robert S. Grumet

See also **Canada** (picture: Canada's Indian heritage).

Haifa, *HY fuh* (pop. 246,500), is a major port and manufacturing and cultural center in Israel. It lies on and around Mount Carmel in northern Israel and is the administrative center of the area. It borders the Bay of Haifa at the eastern end of the Mediterranean Sea (see **Israel** [map]). Haifa has three sections. The lower section, around the bottom of Mount Carmel, includes port facilities, warehouses, apartment buildings, and scattered slums. The main business district covers most of the mountain slopes. The upper part consists mostly of large houses, apartment buildings, and gardens and parks on top of the mountain.

Many religious landmarks are in Haifa, including the Báhá'í Temple, the Monastery of Our Lady of Mount Carmel, and Elijah's Cave. The prophet Elijah hid in the cave to escape from his enemies. Haifa has two universities. Its industries include oil refining and the manufacture of cement, chemicals, electronic equipment, glass, steel, and textiles. Haifa is also a shipping and railroad center.

People lived in what is now the Haifa area about 3,000 years ago. Haifa was a small town until the mid-1850's, when it was first used as a port. Bernard Reich

Haig, *hayg,* **Alexander Meigs, Jr.** (1924-), became secretary of state under President Ronald Reagan in 1981 and resigned the position in 1982. Haig, a retired four-star general, was the second military leader to head the United States Department of State. General George C. Marshall was the first. Haig campaigned for the 1988 Republican presidential nomination, but he attracted little voter support and withdrew early in the race.

Haig was born in Philadelphia on Dec. 2, 1924. He graduated from the U.S. Military Academy at West Point in 1947 and served in Japan, Korea, and other coun-

tries. Haig held a series of posts in the Department of Defense from 1962 to 1965. In 1966 and 1967, he served in combat in the Vietnam War.

In 1969, Haig became senior military adviser to Henry A. Kissinger, then assistant to the President for national security affairs. Haig was promoted to four-star general in 1972. In 1973, he left the Army to serve as White House chief of staff under President Richard M. Nixon.

From 1974 to 1979, Haig served as supreme commander of the North Atlantic Treaty Organization forces in Europe. He retired from military service in 1979 and became president and chief operating officer of United Technologies Corporation, a major manufacturer of aircraft and other products. Lee Thornton

Haig, *hayg,* **Douglas** (1861-1928), one of the most able British generals of his day, commanded Britain's forces in France during World War I (1914-1918). In 1918, he directed several successful offensives, including the attack that broke Germany's defensive Siegfried Line (see **Siegfried Line**). Haig, who took command in France in December 1915, was also associated with two tragic campaigns. His troops suffered over 400,000 casualties in the Battle of the Somme in 1916 and over 240,000 in the Third Battle of Ypres in 1917.

Douglas Haig was born in Edinburgh. After the war, he was made an earl. Ian F. W. Beckett

Haiku. See **Poetry** (Lyric poetry).

Hail is a precipitation in the form of round or irregularly shaped lumps of ice called *hailstones.* Hailstones range from the size of peas to the size of oranges or larger. Most hailstones are smaller than 1 inch (2.5 centimeters) in diameter. Large hailstones can have bumps on their surfaces where they have grown more.

Hail can break windows, damage roofs, dent cars and airplanes, and occasionally injure or kill people. It causes hundreds of millions of dollars of damage to crops each year. Hail damage is greater when the wind is strong.

Hail is often observed from central Texas through the Great Plains states into Alberta. In the United States, it falls most frequently in southeastern Wyoming, western Nebraska, and eastern Colorado. Elsewhere in the world, hail often falls in Argentina, northern Italy, Kenya, South Africa, and the Caucasus region between the Black and Caspian seas.

Hailstones form in thunderstorm clouds and begin as frozen raindrops or snow pellets called *hail embryos.* Embryos originate in one part of the hailstorm and are then carried by air currents to the main region of hail growth. Hailstones develop as the embryos come into contact with *supercooled water droplets,* droplets that remain liquid at temperatures below freezing. As an embryo moves through the droplets, they strike its surface and freeze. An embryo grows into a hailstone as this freezing water accumulates on its surface.

Hailstones become large if they remain for a long time in parts of the hailstorm where there is a large amount of supercooled liquid water. Hailstones grow large if they are supported in the same cloud updraft for a long time. They also grow if they repeatedly fall out of an updraft but are then carried upward by other air currents. Hailstones fall to the ground when they leave the region of updrafts or become too heavy for the air currents to support. They fall at a speed of about 22 miles (35 kilometers) per hour or more. Alexis B. Long

See also **Sleet**; **Storm**.

National Severe Storms Laboratory (NOAA)

The largest hailstone on record, *above,* fell at Coffeyville, Kans., on Sept. 3, 1970. It weighed 1 ¾ pounds (0.76 kilogram) and measured 17 ½ inches (44.5 centimeters) around.

Hail to the Chief is a musical composition used to officially announce the arrival or presence of the President of the United States. Although generally performed as an instrumental work, "Hail to the Chief" is a song. The words come from *The Lady of the Lake* (1810), a poem by Scottish author Sir Walter Scott. James Sanderson, an English composer, set Scott's words to an old Scottish tune, and this song was published in the United States in 1812. The song had achieved its status as a ceremonial tribute to the President by the time James Polk took office in 1845. Katherine K. Preston

Haile Selassie I, *HY lee suh LAS ee* (1892-1975), became emperor of Ethiopia in 1930. His reign ended in 1974, when military leaders overthrew him.

Haile Selassie worked for economic and social reforms, such as making slavery punishable by law. He gave Ethiopia its first written constitution in 1931. Ethiopia was attacked by Fascist Italy in 1935, and Haile Selassie lived in exile in England until 1941. During World War II (1939-1945), British forces assisted in the liberation of Ethiopia and restored him to the throne. Rebels seized the government on Dec. 13, 1960, while he was in South America, but he regained his throne four days later. Haile Selassie was born in Harer. His given and family name was Tafari Makonnen. He became Ras (Duke) Tafari in 1916. He belonged to a *dynasty* (series of rulers) that claimed to be descended from King Solomon and the Queen of Sheba. He took the title Haile Selassie I when he became emperor. *Haile Selassie* means *Power of the Trinity.* Peter P. Garretson

See also **Ethiopia** (History); **Rastafarians**.

Haiphong, *hy fawng* (pop. 1,447,649), is a manufacturing center and seaport in northern Vietnam. The city lies near the Gulf of Tonkin, about 55 miles (89 kilometers) east of Hanoi (see **Vietnam** [map]). Factories in Haiphong produce cement, china, glass, phosphates, and textiles. Other industries include electric power production, food processing, and shipbuilding. The city is a deepwater port for Hanoi. Products shipped to Haiphong are carried by railroad to Hanoi. During the Vietnam War (1957-1975), Haiphong became Communist North Vietnam's major port for importing military supplies. The city was heavily bombed by United States planes. North Vietnam defeated South Vietnam in the war in 1975 and unified the two countries into the single nation of Vietnam in 1976. David P. Chandler

Hair is a threadlike structure that grows from the skin of mammals. Other living things, including bees and some plants, have hairlike coverings on their bodies. But these coverings are not true hair. Most kinds of mammals have a thick coat of hair that serves chiefly to provide warmth. Many species also have certain hairs for special uses, such as for protection or for sense functions. Among human beings, however, hair has primarily a cosmetic value.

Most of the human body is covered by tiny, light-colored hairs that are barely visible. Thick hair grows from the scalp and some other parts of the body. However, certain areas, such as the palms of the hands and the soles of the feet, have no hair at all. In human beings, as in other mammals, hairs around the eyes and ears, and in the nose, serve a protective function. They prevent dust, insects, and other matter from entering these organs. In addition, the eyebrows decrease the amount of light reflected into the eyes.

Among mammals other than human beings, a number of species have special hairs that respond to touch. Many nerves lie around these *tactile hairs,* which are commonly called *whiskers.* Whiskers grow on the lips and cheeks of most mammals, but they also occur on other parts of the body. These hairs help the animals feel their way through narrow or dark places.

Hair also provides protection for animals. The hair color of many mammals blends with their surroundings and helps them hide from their enemies and prey. The quills of porcupines, which also furnish protection against enemies, are a special type of hair. Hair acts as padding against blows and falling objects as well.

Manufacturers use animal hair in making a variety of products. The thick, soft fur that covers some mammals is used for coats and other warm clothing. The woolly fleece of sheep is spun into thread and into cloth for such products as blankets, clothing, and rugs. Felt is manufactured by pressing and matting animal hair. Bristles, the short, stiff hair of hogs, are used in making various kinds of brushes.

The structure and growth of hair

The root and shaft. The part of a hair below the surface of the skin rests in a baglike structure called the *follicle.* The *root,* which is the lowest section of a hair, enlarges at the end into a soft, light-colored structure called the *hair bulb.* Hair develops from the cells of the bulb, which divide rapidly. A structure called the *papilla* projects into the hair bulb at the base of the follicle. It contains connective tissue and blood vessels that supply the blood necessary for the growing cells.

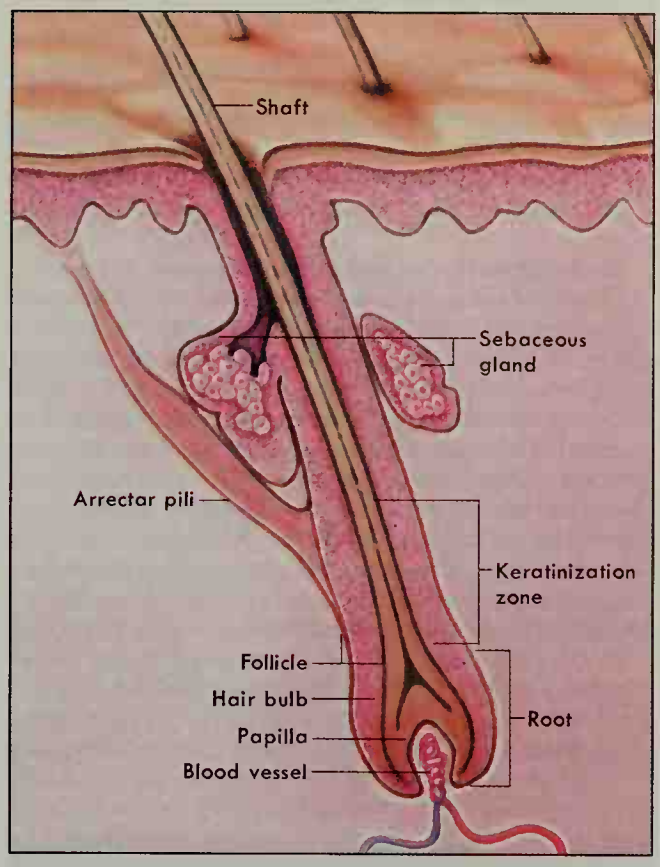
The cells of the hair bulb move upward as new cells begin to form beneath them. As these cells move higher, they are cut off from their nourishment and start to form a hard protein called *keratin.* This protein is found in the nails, claws, and hoofs of mammals; the scales of reptiles; and the feathers of birds. The formation of keratin is called *keratinization.* The hair cells die as it occurs.

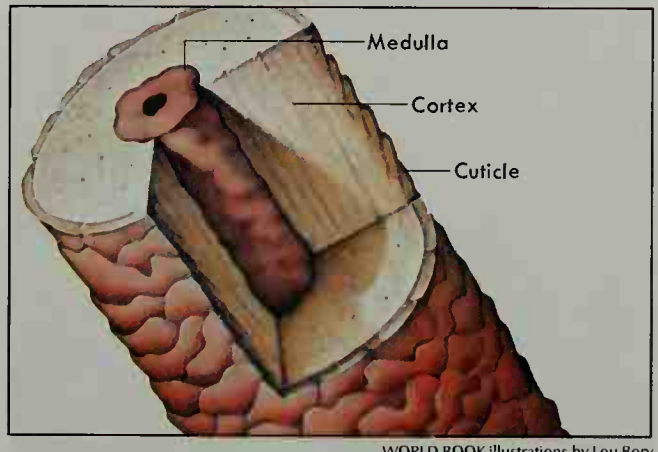
The keratinization process is completed by the time the hair has risen about a third of the way to the surface of the skin. The part of the hair above where keratinization has occurred is called the *shaft.*

Three layers of dead cells compose the shaft of a hair. The outer layer, called the *cuticle,* consists of flattened

The parts of a hair

The top diagram shows the parts of a human hair. A hair develops from the cells of the hair bulb. These cells move up to form the root and then the shaft of the hair. The bottom diagram shows the three layers of dead cells that make up a hair shaft.





WORLD BOOK illustrations by Lou Bory

cells known as *cuticular scales.* Beneath the cuticle lies the *cortex,* a layer of tightly packed, cigar-shaped cells. The cortex contains the *pigment* (coloring matter) that determines the color of hair. The core of the shaft, called the *medulla,* is made up of loosely packed, boxlike cells.

Glands and muscles. Most hair follicles contain an oil gland called the *sebaceous gland.* This gland secretes oil into the follicle. The oil flows over the hair, lubricating it and keeping it soft.

A muscle known as the *arrector pili* is attached to most hair follicles. When this muscle contracts, it causes a hair to "stand on end." In mammals with heavy coats,

hair in this position traps air close to the animal's body, providing extra insulation against the cold. Hair standing on end also makes an animal look larger and more dangerous. When a human being is cold or frightened, the muscles contract and produce little bumps around the hair. These bumps are commonly known as "goose bumps."

Color and texture. The color of hair is determined largely by the amount and distribution of a brown-black pigment called *melanin*. Hair also contains a yellow-red pigment that is most visible in people whose hair has little melanin. Most people's hair gradually becomes gray or white as they grow older, because pigment no longer forms.

The texture of hair depends largely on the shape of the hair, which can be seen in cross section under a microscope. Straight hairs have a round shape, and wavy and curly hairs are flat. The flattest hairs are the waviest or curliest.

Cycles of hair growth. The growth of hair in the follicles occurs in cycles. In each cycle, a follicle goes through a growth phase, called *anagen,* and a resting phase, called *telogen*. A hair stops growing during every telogen, when it is known as a *club hair*. The club hair stays in the follicle until the next growing phase. In the growing phase, the club hair is shed as a new hair grows and pushes it out of the follicle.

The length of hair depends on the length of the growing phase of the follicle. The follicles in the human scalp are active for two to six years, and then they rest for about three months. Scalp hairs grow less than half an inch (13 millimeters) per month. Shorter hairs, such as those in the eyebrows and eyelashes, grow for about 10 weeks and then rest for 9 months.

The human scalp contains an average of about 100,000 hairs. From 5 to 15 per cent of the hairs in the scalp are in the resting stage at any time. A person sheds from 70 to 100 hairs a day from follicles that are in the resting stage.

Many factors affect the growth of hair. They include age, diet, general health, and changes in the seasons. For example, hair grows faster in children than in adults, and it grows faster in summer than during any other season. Cutting or shaving hair on any part of the body does not have any effect on the future growth or texture of the hair.

Tony Brain, Science Photo Library

The shaft of a hair, shown highly magnified, consists of three layers of dead cells. The outer layer, *above,* called the *cuticle,* is made up of flattened cells known as *cuticular scales.*

Disorders of the hair and scalp

Baldness occurs if the follicles on the scalp die and no longer produce new hair. Heredity is the most common cause of baldness. However, other factors, including scalp infections and reactions to drugs or radiation, can also cause it. Baldness caused by heredity is more common in men than in women. Such baldness cannot be cured.

Various factors, including illness and pregnancy, can affect the growth cycles of the hair follicles. The growing phases of the follicles are shorter in such cases, and a large number of club hairs occur. These club hairs may be shed at one time, causing thinning of the hair or even baldness. This type of hair loss is not permanent because new hairs grow after the growing cycles start again.

Excess hair on the face or elsewhere can also be caused by heredity or by certain medical problems. Such hair can be removed by a process called *electrolysis*. This process, in which the papillae are destroyed by an electric needle, prevents new hair from growing. Unwanted hair above the surface of the skin can be removed by the application of a liquid or paste that is called a *depilatory*. However, the root of the hair stays alive, and so the hair grows out again.

Other scalp disorders include *dandruff, ringworm,* and *head lice*. Dandruff consists of scales of skin that fall from the scalp. It does not cause hair loss unless accompanied by an infection severe enough to damage the follicles. Ringworm is an infection caused by tiny organisms called *fungi,* which feed on the keratin. The hairs break off, leaving bare areas on the scalp. Head lice are insects that suck blood from the scalp and attach their eggs to hairs. David T. Woodley

Related articles. For information on the care of the hair, see Hairdressing. Other related articles in ***World Book*** include:

Baldness
Beard
Dandruff
Felt
Fur
Keratin
Louse
Mammal (Skin and hair)
Races, Human
Ringworm
Skin (Hair, nails, and glands)
Wool

Hair hygrometer. See Hygrometer (The hair hygrometer).

Hair snake. See Horsehair worm.

Hair transplanting. See Baldness.

Hairball. See Cat (Grooming).

Hairbell. See Bluebell.

Detail of an Egyptian limestone relief of *Amenmes and His Wife* (about 1300 B.C.); The Louvre, Paris

Ancient Egyptians wore long wigs of spiral curls, such as those worn by this nobleman, *left,* and his wife, *right.* The curls were made of human hair, palm-leaf fibers, or wool.

Hairdressing is the art of cutting, setting, arranging, and otherwise caring for the hair. Women and men style their hair to improve their appearance and for comfort. A different hairstyle can alter a person's appearance more than almost any other physical change. Hairdressing can accent good features and hide bad ones, or draw attention away from undesirable characteristics. It provides attractive, easy-to-manage hairstyles that meet the needs and desires of the people who wear them.

Hair is the most easily changed physical feature of the human body. Since prehistoric times, people have cut, braided, and dyed their hair and changed it in other ways as well. Professional hairdressers first became common during the 1700's. Today, most women and men depend on hairdressers for such services as cutting, coloring, straightening, and permanent waving. Hairdressers are also known as *beauticians, beauty operators, cosmetologists,* and *hairstylists.* Those hairdressers who work mainly with men's hair are usually called *barbers.*

Vidal Sassoon, the contributor of this article, is one of the world's leading hairdressers. He is Chairman of the Board of Vidal Sassoon, Inc.; author of Sorry I Kept You Waiting, Madam; *and coauthor of* A Year of Beauty and Health.

Hairdressing through the ages

People painted and tattooed their bodies during prehistoric times, and they probably also arranged their hair in various ways. Archaeologists have discovered hairpins and hair ornaments from the New Stone Age, which began about 8000 B.C.

Ancient times. In ancient Egypt, both men and women shaved their heads for cleanliness and relief from the heat. However, they frequently wore long wigs made of braids or spiral curls stitched to a woven foundation. These wig styles lasted for centuries.

In ancient Greece and Rome, most people wore a narrow band called a *fillet* around their heads to hold their hair in place. Fashionable men frizzed their hair and powdered it with gold dust. Women braided, curled, or tied their hair into fancy styles. Many women bleached their hair blond.

Two early Germanic peoples, the Angles and the Saxons, dyed their hair blue, green, or orange. The ancient Gauls, who lived in France, colored theirs red.

The Middle Ages began in the late 400's and lasted until about the 1400's. Hairstyles changed little during this period. Most men wore medium-length hair that reached no lower than their shoulders. Priests and monks had a shaved patch called a *tonsure* on the crown of the head. Girls and unmarried women wore their hair loose. Married women covered theirs with a veil or a hoodlike covering. Sometimes they plucked or shaved the hair at the hairline to make the forehead seem higher.

The Renaissance. Women wore many hairstyles during the Renaissance, which began in Italy about 1300 and spread throughout Europe during the 1400's and 1500's. Some had long braids that fell to their knees.

Marble sculpture (about 100 B.C.); Museo Civico, Bologna, Italy (Raymond V. Schoder, S.J.)

A fillet was a band worn by ancient Greeks and Romans to hold their hair in place. This sculpture is probably of the Greek goddess Athena.

Detail of *Lady in Yellow* (about 1465) by Alesso Baldovinetti; National Gallery, London

A woman of the 1400's plucked or shaved her hair at the hairline to make her forehead seem higher. Blond hair was extremely fashionable.

Detail of a painting (about 1700); Musee des Beaux-Arts, Orleans, France (Lauros-Giraudon)

A periwig was a huge, curly wig worn by men of the 1600's and 1700's. The wig might be unpowdered, like this one, or covered with white powder.

Detail of *Marie-Thérèse of Savoy* (1700's) attributed to Antoine Callet; Versailles, France

A towering hairdo of the mid-1700's was supported by a wire frame. Such hairstyles were decorated with flowers, jewels, or other ornaments.

Others drew their hair back into a large roll called a *chignon* at the back of the head. A hairstyle called *Venus' hair* featured thick strands, stiffened with gold lacquer, that seemed to flow from the head. Blond hair was extremely fashionable, and women spent long hours in the sun to bleach their hair.

Most men wore short or shoulder-length hair, and many had bangs covering the forehead. King Henry VIII of England ordered Englishmen to wear short hair in imitation of French noblemen.

The 1600's. Most men of the 1600's had long, flowing curls. Many wore a side curl called a *lovelock,* which was longer than the other curls and tied with a ribbon. During the Civil War in England (1642-1649), the chief opponents of King Charles I were the Puritans. They were called *Roundheads* because they had their hair cut close to their heads. Their short haircuts distinguished them from the king's supporters, a group called the *Cavaliers,* who had long hair. King Louis XIII of France started a fashion for men's wigs after he lost his own hair. Many men wore huge, curled wigs called *periwigs.*

During much of this period, women wore their hair piled high on their heads. However, curls that fell to the shoulders were fashionable in the mid-1600's.

The 1700's. Fancy hairstyles became popular with both women and men during the 1700's. Women's hairdos were extremely high and had to be supported by small cushions and wire frames. Many styles measured more than 2 feet (60 centimeters) high and had floral, operatic, or poetic themes. Women covered their hair with white or pastel powder and decorated their hairdos with feathers, jewels, tassels, or other ornaments. Sometimes they did not wash or comb their hair for several weeks because the styles were so complicated. Professional hairdressers became common to help create and care for such hairdos.

Men covered their hair with powdered wigs. The most popular wig styles were smaller than those of the 1600's. A style called a *tie wig* was pulled back and tied with a short ribbon. The ends of a *bag wig* were covered with a silk bag.

The 1800's brought simpler hairstyles. Fashionable styles for women included braids, topknots, and heavy coils of hair over each ear or at the nape of the neck. Long, smooth curls shaped like sausages were stylish during the 1840's. In the 1870's, a French hairdresser named Marcel Grateau invented the *marcel wave,* a series of deep, soft waves made with heated tongs. Another French hairdresser, Alexandre F. Godefroy, invented a hairdrier about 1890. Godefroy's clients wore a bonnetlike covering that was attached to the chimney pipe of a gas stove. Beginning in the 1890's, fashionable women wore their hair up in a soft style called the *Gibson girl look.* This style was made popular by the American artist Charles Dana Gibson.

Men wore their hair short during the 1800's and dressed it with hair oil, particularly *Macassar oil.* This type of oil became so popular that protective coverings called *antimacassars* were made for chairs and sofas.

The 1900's. Hairdressers of the 1900's developed new processes for curling the hair. Charles L. Nessler, a German-born hairdresser, invented the permanent wave about 1905. Nessler first applied a borax paste and then wound the hair on electrically heated curlers. The permanent-wave treatment took up to 12 hours and cost hundreds of dollars.

During the 1920's, many women cut their hair in a short style called the *bob* and had it permanent-waved. The *cold wave,* a permanent wave that did not require heat, was developed in the 1930's. A cold wave took about two hours and cost only a few dollars.

During the 1940's, many women wore the *sheepdog,* or *Veronica Lake,* style. This hairstyle was made popular by Veronica Lake, a motion-picture star who had long hair that covered one eye. In the 1950's, large numbers of women began to color their hair or *frost* their hair—that is, bleach a few strands. The puffy appearance of *bouffant* hairdos was stylish in the late 1950's and early 1960's. To give their hair the necessary fullness, women combed it from the ends toward the scalp in a process called *backcombing* or *teasing.*

Men wore their hair short throughout the early and

From *The Best of Charles Dana Gibson* © 1969, by Crown Publishers, Inc.

The *Gibson girl look,* a soft, puffy hairstyle of the 1890's, was created by the American artist Charles Dana Gibson.

Artstreet

The crew cut, in which a man's or boy's hair is cut very short and brushed upward, was popular during the 1950's.

© Paul Fusco, Magnum

The Afro, a hairdo popular in the 1960's and 1970's, resembles bushy hairstyles worn by many African men and women.

Vidal Sassoon Salons, Inc. (WORLD BOOK photo)

Modern hairdressers create many styles by cutting the hair so that it falls into place and needs no setting. Such styles can be blown dry with a hand drier or allowed to dry naturally.

mid-1900's. During the 1920's, many young men wore *patent leather hair,* which they slicked down with oil in the manner of the movie star Rudolph Valentino. During the 1950's, some men wore a *crew cut,* in which the hair was cut extremely short and combed upward to resemble a brush. Other men of the same period wore a *ducktail.* This style left the hair long on the sides and swept it back, so that it looked somewhat like a duck's tail. During the 1960's, young men copied the haircuts of the Beatles, a British rock music group, who wore long bangs that covered the forehead.

A number of *unisex* styles, which were fashionable for both sexes, appeared during the 1960's and 1970's. Many people wore their hair long, either straight or curly; or in a bushy style called the *Afro.* In the 1980's and 1990's, shorter hairstyles became more popular.

Caring for the hair

Clean, healthy hair results from regular brushing and shampooing, and a well-balanced diet. Brushing removes dirt and tangles and spreads the natural scalp oils through the hair. Dry hair should be washed about once a week. Oily hair may need a daily washing.

Most people handle the daily care of their hair at home. They visit a hairdresser only for haircuts, coloring, straightening, or permanent-waving. Many styles need no setting and can be blown dry with a hand drier or allowed to dry naturally.

Careers in hairdressing

A high school student who wishes to become a hairdresser should study a broad range of subjects, including the arts, biology, and psychology. Courses in the arts help develop creativity and artistic ability. Biology courses aid in understanding the structure and growth of the hair. A knowledge of psychology helps in dealing with people.

A student may attend a professional hairdressing school or serve an apprenticeship under an established hairdresser. Most European hairdressers serve an apprenticeship. In the United States, most students take a 6- or 12-month course at a state-licensed cosmetology school. They learn to shampoo, cut, color, style, and straighten and permanent-wave hair. They also learn to give manicures, scalp and facial treatments, and advice on makeup. Many students also take courses in the treatment of disorders of the hair and scalp.

All the states require hairdressers to have a license. State boards of cosmetology establish licensing requirements, which vary from state to state.

The chief professional associations for hairdressers in the United States are the Associated Master Barbers and Beauticians of America, the National Beauty Culturists' League, and the National Hairdressers and Cosmetologists Association. Major professional publications for hairdressers include *American Hairdresser/Salon Owner, Beauty World, The Hairstylist, Journeyman Barber and Beauty Culture,* and *Modern Salon Magazine.*

Vidal Sassoon

Related articles in *World Book* include:

Barber
Beard
Clothing (Clothing through the ages; pictures)
Colonial life in America (Clothing)
Cosmetics
Dandruff
Hair
Wig

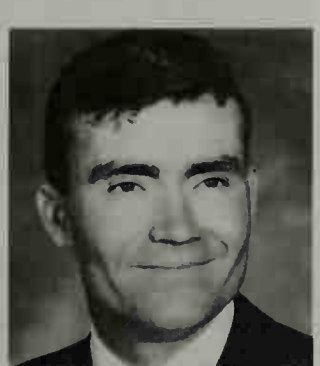
Hairworm. See Horsehair worm.

Haise, Fred Wallace, Jr. (1933-), served as lunar module pilot of the United States Apollo 13 space flight in April 1970. About 56 hours after the flight began, an explosion caused by a short circuit severely damaged the systems that supplied electricity and oxygen to the command module. Haise and his two fellow astronauts retreated into the lunar module, which had enough oxygen to keep them alive during their return to the earth. In 1977, Haise flew the first manned space shuttle test flight with Gordon Fullerton.

Haise was born in Biloxi, Mississippi. He became a naval aviation cadet in 1952. Haise also served with the U.S. Marine Corps, the Air National Guard, and the Air Force. He graduated from the University of Oklahoma in 1959. Haise was a test pilot, instructor, and fighter pilot from 1959 until he became an astronaut in 1966.

Haise resigned from the space program in 1979. He joined Grumman Corporation in 1979 as vice president of space programs. He later became president of Grumman Technical Services and president of Grumman's Space Station Program Support Division. After Northrop Corporation acquired Grumman in 1994, Haise became a vice president of the combined company, Northrop Grumman Corporation.

Lillian D. Kozloski



NASA

Fred W. Haise, Jr.

Arnold H. Crane from Marilyn Gartman

The National Palace in Port-au-Prince is the official home of the president of Haiti. It also houses some of Haiti's government offices. Haiti has been an independent nation since 1804. But during most of its history, the country has been ruled by dictators.

Haiti, *HAY tee,* is a country in the West Indies. It covers the western third of the island of Hispaniola, which lies between Cuba and Puerto Rico in the Caribbean Sea. The Dominican Republic covers eastern Hispaniola. Most of Haiti is mountainous, and the country's name comes from an Indian word that means *high ground.*

Haiti is one of the most densely populated and least developed countries in the Western Hemisphere. Most Haitians are farmers who raise barely enough food to feed their families. The country has a shortage of hospitals and doctors. Because of poor diet and medical care—especially in rural areas—the average Haitian lives only about 50 years.

Haiti is the oldest black republic in the world. In addition, it is the second oldest independent nation in the Western Hemisphere. Only the United States is older. Haiti has been independent since 1804, but most of the time it has been ruled by dictators who have not been interested in the welfare of the people.

Christopher Columbus arrived at Hispaniola in 1492. His crew established a Spanish base in what is now Haiti. Later, French settlers developed Haiti into what was then the richest colony in the Caribbean.

Haiti's official name in French is République d'Haiti. Its official name in Creole is Repiblik dAyiti. Both official names mean Republic of Haiti. Port-au-Prince is Haiti's capital and largest city.

Government. A president heads the government of Haiti. The people elect the president to a five-year term. A parliament called the National Assembly makes the country's laws. The upper house, called the Senate, has 27 members. The members are elected by the people to six-year terms. The lower house, called the Chamber of Deputies, has 83 members, elected to four-year terms.

People. Most of the people are descendants of black Africans brought to Haiti as slaves. Most live in the country's overcrowded coastal plains and mountain valleys, where the soil is most productive. A typical Haitian family farms a tiny plot of land that was once part of a plantation where the family's ancestors worked as slaves. The family raises beans, corn, rice, and yams to eat. If they are fortunate, they may have chickens, a pig, or a goat. They live in a one-room hut that has a thatched roof and walls made of sticks covered with dried mud.

Most Haitians still follow some of the customs their ancestors brought from Africa. Much of the work on the small farms of Haiti is done by people who move from field to field, planting or harvesting crops to the sound of music and singing. This combination of work and play is called a *combite* (also spelled *coumbite*).

Most Haitians belong to the Roman Catholic Church. However, many of their beliefs and practices have been strongly influenced by African religions. As a result, a form of religion traditionally known as *voodoo* exists in Haiti. People who follow voodoo, also spelled *vodou,* believe that by performing certain ceremonies they can

Facts in brief

Capital: Port-au-Prince.
Official languages: Creole and French.
Area: 10,714 mi² (27,750 km²). *Greatest distances*—east-west, 180 mi (290 km); north-south, 135 mi (217 km). *Coastline*—672 mi (1,081 km), including offshore islands.
Elevation: *Highest*—Pic La Selle, 8,783 ft (2,677 m) above sea level. *Lowest*—sea level.
Population: *Estimated 2002 population*—8,494,000; density, 793 per mi² (306 per km²); distribution, 66 percent rural, 34 percent urban. *1982 census*—5,053,792.
Chief products: *Agriculture*—coffee, sisal, sugar cane.
National anthem: "La Dessalienne" ("Song of Dessalines").
Flag: The dark blue top half of the *national flag,* flown by the people, stands for the blacks of Haiti; the red bottom half represents its mulattoes. In the center of the *state flag,* used by the government, is the Haitian coat of arms. See Flag (picture: Flags of the Americas).
Money: *Basic unit*—gourde. One hundred centimes equal one gourde.

be possessed by gods. For example, a *houngan* (voodoo priest) draws designs on the ground with flour. Then, the people dance until they believe a god has possessed one or more of them. Followers of voodoo believe in many gods, such as those of rain, love, war, and farming. A growing number of Haitians have become Protestants.

About 5 percent of Haiti's people are *mulattoes* (people of mixed black and white ancestry). Most mulattoes belong to the middle or upper class, and many have been educated in France. Most live in modern houses and are merchants, doctors, or lawyers. A few Americans, Europeans, and Syrians also live in Haiti. Most Haitians speak Creole, a language partly based on French. The middle and upper classes also speak French. For Haiti's literacy rate, see **Literacy** (table: Literacy rates).

Land. Two chains of rugged mountains run across the northern and southern parts of Haiti and form two peninsulas at the west end of the island. The northern peninsula juts about 100 miles (160 kilometers) into the Atlantic Ocean, and the southern peninsula extends about 200 miles (320 kilometers) into the Caribbean Sea. A gulf, Golfe de la Gonâve, and an island, Île de la Gonâve, lie between the two peninsulas. The wide Artibonite Valley of the Artibonite River lies between the mountains in eastern Haiti. Tortue Island (also called Tortuga Island) lies off the northern coast. Cedrela and mahogany forests cover some mountains, and tropical fruit trees grow on others.

The people farm as much of the land as they can. In some areas, they raise crops on slopes so steep that the farmers anchor themselves with ropes to keep from sliding down the hillside. The people grow coffee and *cacao* (seeds used to make cocoa and chocolate) in the mountains. Sugar cane is the main crop in the black, fertile soil of the Artibonite Valley.

Haiti has a tropical climate with mild temperatures. Temperatures range from 70 to 95 °F (21 to 35 °C) along the coasts and from 50 to 75 °F (10 to 24 °C) in the mountains. The tropical forests in the northern mountains receive about 80 inches (200 centimeters) of rain a year. The southern coast receives less than 40 inches (100 centimeters). Destructive hurricanes sometimes strike the country between June and October.

Economy. Most of Haiti's workers farm for a living. But most farmers own less than 2 acres (0.8 hectare) of land, barely enough to grow food for their families. Some people who live in the mountains raise fruits and coffee beans that they sell in the marketplaces. A few mulattoes own large plantations, where laborers raise coffee, sugar cane, or *sisal* (a plant used to make twine). Many Haitians work on plantations in the Dominican Republic and Cuba.

Haiti has few industries. Coffee and sugar cane are processed there and sold to the United States, France, and other countries. Haiti also has a few cotton mills. Craftworkers in the cities sell tourists handicrafts woven from sisal or carved out of mahogany. Haiti imports small amounts of cotton goods, grain, and machinery.

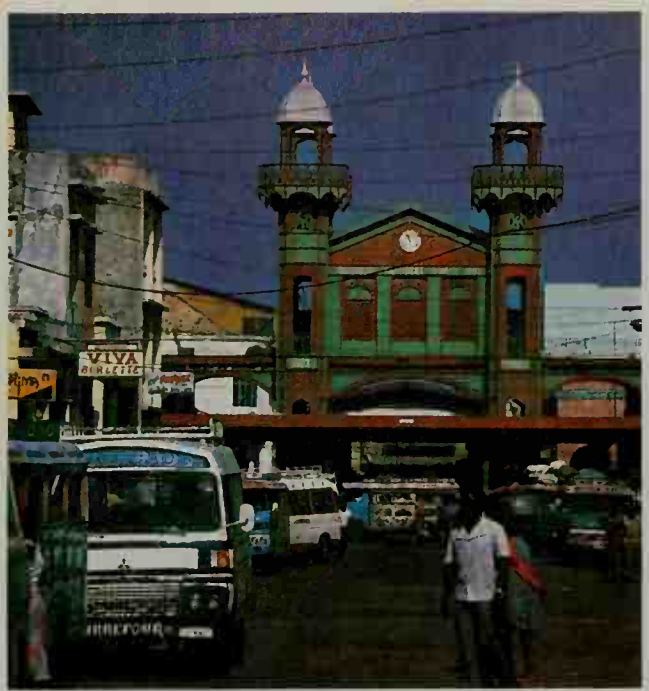
Several international airlines make stops in Port-au-Prince. The cities of Cap-Haïtien, Les Cayes, and Saint-Marc are important seaports. Cruise ships stop at Cap-Haïtien, and many passengers visit the city. Haiti has only about 50 miles (80 kilometers) of railroad track. Most of the track is on the sugar plantations.

History. Christopher Columbus arrived at Hispaniola in 1492. One of his ships, the *Santa Maria,* ran aground on Christmas Day on reefs near the present-day city of Cap-Haïtien. Columbus's crew used the ship's timber to build a fort, which Columbus named Fort Navidad. Some of the crew stayed to hold the fort when Columbus sailed on. But the Arawak Indians who lived on the island destroyed the fort and killed the men.

Haiti

International boundary
Road
Railroad
National capital
Other city or town
Elevation above sea level

WORLD BOOK maps



Gerald S. Adams, Shostal

The gateway to the Iron Market in Port-au-Prince is framed by Moorish-style turrets. In the market, merchants sell food, clothing, and many other items in indoor and outdoor stalls.

Columbus discovered gold in what is now the Dominican Republic. Other Spanish settlers then rushed to Hispaniola. They forced the Indians to mine gold and raise food. They treated the Indians so harshly that by 1530 only a few hundred Indians were alive. The settlers then brought in slaves from Africa to work for them.

Spanish settlers began leaving Hispaniola for more prosperous Spanish settlements in Peru and Mexico. By 1606, there were so few Spaniards left on Hispaniola that the king of Spain ordered them to move closer to the city of Santo Domingo (in what is now the Dominican Republic). French, English, and Dutch settlers then took over the abandoned northern and western coasts of Hispaniola. Many settlers became pirates called *buccaneers*. The buccaneers used the small island of Tortue (also called Tortuga) as a base and attacked ships carrying gold and silver to Spain. The Spanish tried to drive out the buccaneers but failed. In 1697, Spain recognized French control of the western third of the island.

France named its new colony Saint Domingue. French colonists brought in African slaves and developed big coffee and spice plantations. By 1788, there were eight times as many slaves (almost 500,000) as colonists.

In 1791, during the French Revolution, the slaves in Saint Domingue rebelled against their French masters. The slaves destroyed plantations and towns. Toussaint L'Ouverture, a former slave, took control of the government and restored some order to the country. But after Napoleon I came to power in France in 1799, he sent an army to restore colonial rule. The army sent by Napoleon captured Toussaint and imprisoned him in France. However, many of the French soldiers caught yellow fever and died, and the rebels defeated the weakened French army in 1803. On Jan. 1, 1804, General Jean-Jacques Dessalines, the leader of the rebels, proclaimed the colony an independent country named Haiti.

Dessalines became the nation's first chief of state. When he was killed in 1806, two other generals, Alexandre Pétion and Henri Christophe, struggled for power. Pétion took control of southern Haiti and Christophe took control of the northern part of the country. Jean-Pierre Boyer replaced Pétion in 1818 and reunited the country after Christophe committed suicide in 1820. In 1821, Boyer took control of the Spanish colony in eastern Hispaniola. Haiti ruled it until the colony revolted in 1844. During the next 70 years, 32 different men ruled Haiti. Unrest spread throughout the country.

In 1915, U.S. President Woodrow Wilson sent marines to Haiti to restore order. He feared other nations might try to take Haiti if unrest continued. Haitians resented this interference. The U.S. occupation force made Haiti make payments on its large debts to other countries. It strengthened the government, built highways, schools, and hospitals, and set up a sanitation program that eliminated yellow fever in Haiti. The U.S. force withdrew in 1934, and Haiti regained control of its own affairs. The next two Haitian presidents encouraged foreign companies to invest money in Haiti. But the upper-class mulattoes gained most from these investments.

Army officers took control of Haiti's government in 1946, and again in 1949 after riots broke out. An army officer, Paul Magloire, was elected president in 1950. He resigned in 1956 when rioting broke out, and the army took control of the government again.

François Duvalier, a country doctor, was elected president of Haiti in 1957. In 1964, he declared himself president for life. Duvalier ruled as a dictator. In 1971, Haiti's Constitution was amended to allow the president to choose his successor. Duvalier chose his son, Jean-Claude. François Duvalier died in April 1971. Jean-Claude, then only 19 years old, succeeded him. He also declared himself president for life and ruled as a dictator. Both the Duvaliers controlled Haiti's armed forces and a secret police force. The secret police enforced the Duvaliers' policies, often using violence. The people called the secret police *Tontons Macoutes* (bogeymen).

© Carl Frank, Photo Researchers

Sugar cane is one of Haiti's major crops. These rural laborers are loading the cane onto trucks for shipment to a mill.

In the early 1970's, many Haitians left due to poor economic conditions and severe treatment by the secret police. In 1986, Haitians staged a revolt against Jean-Claude Duvalier. Jean-Claude fled from Haiti. Lieutenant General Henri Namphy became head of the government. Namphy tried to disband the Tontons Macoutes but failed.

A constitution adopted in March 1987 provided for presidential and national assembly elections by the people. But the government tried to shift control of the elections from a civilian electoral council to the army. The presidential election was to be held on Nov. 29, 1987. But as a result of terrorist attacks on voters at polling places, the election was canceled. In January 1988, new elections were held. The voters elected a parliament and a civilian president. In June 1988, Namphy overthrew the government and seized power. He declared himself president of a military government.

In September 1988, officers of Haiti's Presidential Guard seized power from Namphy. Lieutenant General Prosper Avril declared himself president and began to rule as a dictator. In March 1990, Avril resigned his office after protests against his rule.

In December 1990, the Haitian people elected Jean-Bertrand Aristide as president. However, in September 1991, military leaders overthrew Aristide. Aristide fled the country. The Organization of American States (OAS), an association of North and South American nations, led a trade boycott against Haiti designed to force Aristide's return to power. The United Nations (UN) later imposed its own boycott. Following the coup, many Haitians attempted to flee to the United States in small boats. At first, the U.S. government forced most of the refugees to return to Haiti. Later, the government sent fleeing refugees to the U.S. military base at Guantánamo Bay, Cuba.

On July 3, 1993, the Haitian military agreed to allow Aristide to return to office and restore a democratic government by October 30. But the military leaders failed to carry out the agreement and barred him from returning. The UN and the United States demanded that the agreement be followed. On Sept. 18, 1994, the United States began sending troops to Haiti to force the Haitian military to do so. The military then agreed to give up control and allow Aristide to return. United States troops remained to help keep order. Aristide returned to office in October. The OAS and UN boycotts were then ended. The refugees at Guantánamo returned to Haiti. Most U.S. troops left Haiti in March 1995, though some remained as part of a UN peacekeeping force. In late 1995, René Préval was elected president. He took office in early 1996. The United States withdrew the last of its combat troops in April 1996. UN peacekeepers withdrew in December 1998. In 2000, Aristide was again elected to the presidency. Gary Brana-Shute

Related articles in *World Book* include:

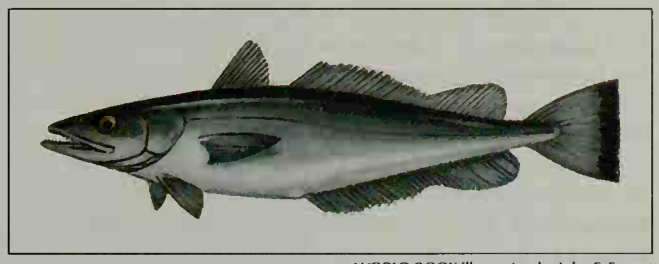
Aristide, Jean-Bertrand
Cap-Haïtien
Christophe, Henri
Columbus, Christopher
Dessalines, Jean-Jacques
Dominican Republic
Duvalier, François
Port-au-Prince
Toussaint L'Ouverture
Voodoo (with picture)
West Indies

Additional resources

Cheong-Lum, Roseline Ng. *Haiti.* 1995. Reprint. Cavendish, 1998. Younger readers.

Haggerty, Richard A., ed. *Dominican Republic and Haiti: Country Studies.* 2nd ed. U.S. Government Printing Office, 1991.

Hajj, *haj,* also spelled *hadj,* is a holy pilgrimage to Mecca, the holy city of the Islamic religion. The Kaaba, the most sacred shrine of Islam, is in Mecca and is the chief goal of the pilgrimage. The Islamic religion requires every Muslim to make this journey at least once, if possible. Going on the hajj is one of the five *pillars* (duties) of Islam. The hajj includes a number of ceremonies that last several days. Muslims believe a person who makes the hajj secures great religious merit. Such a person is called a *hajji* and is held in esteem. See also Kaaba; Mecca; Muslims. Richard C. Martin



WORLD BOOK illustration by John F. Eggert

A hake has two fins on its back and a long fin on its underside. Hakes feed on shrimp, squid, and even other hakes.

Hake is the name of a group of food fish closely related to the cod. Hakes live in most coastal areas of the Atlantic Ocean and the eastern Pacific Ocean.

Commercial fishing crews use a variety of techniques to catch hakes. One of the most efficient ways includes a *trawl* (large, cone-shaped fishnet). Some hakes are sold either fresh or frozen. Others are used as animal feed.

True hakes have two fins on the back, with a notch in the second fin, and a long fin on the underside. These fish vary in color. Many are brown to gray on top and silver to white on the belly and sides. Some true hakes reach about 4 feet (1.2 meters) in length and weigh up to 50 pounds (23 kilograms). But most weigh less than 8 pounds (3.6 kilograms).

Some species of fish that are commonly called hakes are in the codfish family. These fish may have fins on the back or underside that extend into long, narrow feelers.

Hakes feed on shrimp, squid, and even other hakes. They swim in *schools* (groups) when hunting.

Robert R. Rofen

Scientific classification. Most scientists classify true hakes in the merluccid hakes family, Merlucciidae. Others classify them in the codfish family, Gadidae.

Halas, *HAL uhs,* **George Stanley** (1895-1983), was a pioneer of professional football. He owned, coached, and played for the Chicago Bears, one of the original teams of the National Football League (NFL). Halas helped develop a wide-open offensive style of play that increased the popularity of the NFL. His other innovations include using film sessions and daily practices to prepare for games.

Halas was born in Chicago. In 1920, he organized and played end for the Decatur (Illinois) Staleys. In 1922, the Staleys became the Chicago Bears. Halas ended his playing career in 1929. He coached the Bears from 1920 to 1929, from 1933 to 1942, from 1946 to 1955, and from 1958 to 1967. He won 324 games, an NFL record until it was broken by Don Shula. Halas won NFL championships in 1933, 1940, 1941, 1946, and 1963. In 1963, he was

made a charter member of the Pro Football Hall of Fame.

Carlton Stowers

Hale, Edward Everett (1822-1909), was a Unitarian clergyman, editor, and humanitarian. He wrote many books, but only the short story "The Man Without a Country" (1863) has remained well known. It is the story of a young Army officer, Philip Nolan, who exclaimed during his trial by court-martial that he wished he would never hear of the United States again. Nolan was put on a ship with instructions that no one was ever again to give him any news of his own land. But before he died, he redeemed himself and begged for reconciliation with his country. Hale's story caused such a sensation that many people failed to realize that it was fiction. It has been said that Hale's formula in his stories was to take an impossible situation and make it appear probable by simplicity and directness.

Hale was born in Boston, son of Nathan Hale, first editor of the *Boston Daily Advertiser,* and grandnephew of Nathan Hale, the Revolutionary War hero (see Hale, Nathan). As a youngster, he wrote stories and printed them. He also published a small newspaper which he circulated among his relatives and neighbors.

Hale graduated from Harvard College when he was 17. He became pastor of the Church of the Unity, in Worcester, Massachusetts, in 1846. He moved 10 years later to the South Congregational Church in Boston and stayed there for 43 years.

His works include *A New England Boyhood* (1893) and the story "My Double, and How He Undid Me" (1859). He himself thought his best book was the novel *In His Name* (1873). Hale edited a monthly magazine, *Old and New,* for five years, and worked for the New England Emigrant Aid Society. He was a leader in the Lend-a-Hand charity movement, whose motto was "Look up and not down, look forward and not back, look out and not in, lend a hand."

Bert Hitchcock

Hale, George Ellery (1868-1938), was an American astronomer who pioneered in the development of instruments for studying the sun. He also planned the construction of several giant telescopes, including the Hale Reflecting Telescope at the Palomar Observatory near San Diego. This instrument has a diameter of 200 inches (508 centimeters).

Hale was born in Chicago and graduated from the Massachusetts Institute of Technology. In 1891, he introduced the *spectroheliograph,* an instrument that enables astronomers to photograph the surface of the sun with light of a single wavelength. Photographs made with it reveal the distribution on the sun's surface of such elements as calcium, hydrogen, and iron. Hale also made important discoveries about sunspots. For example, he proved that these dark areas on the sun have strong magnetic fields. In 1895, Hale founded the *Astrophysical Journal,* which became the leading journal for astronomers. He founded and was first director of the Yerkes Observatory in Wisconsin and, later, the Mount Wilson Observatory in California.

Thomas E. Lutz

Hale, John Parker (1806-1873), an American politician from New Hampshire, was a leading opponent of slavery before the Civil War. Hale served in the United States House of Representatives from 1843 to 1845. In 1845, the Democratic Party refused to renominate him because he opposed the admission of new slave states into the Union. Hale served in the U.S. Senate from 1847 to 1853 and from 1855 to 1865. During the Civil War (1861-1865), he was chairman of the Senate Committee on Naval Affairs. He was nominated for president by the Liberty Party in 1848, but he withdrew when the party merged with the Free Soil Party. In 1852, he was unsuccessful in his bid for the presidency on the Free Soil ticket. He served as minister to Spain from 1865 until 1869. Hale was born in Rochester, New Hampshire.

Michael F. Holt

Hale, Nathan (1755-1776), was an American patriot of the Revolutionary War. He was hanged by the British as an American spy when he was only 21 years old. His conduct and his courage have made him one of America's most-remembered heroes.

Hale, one of 12 children, was born in Coventry, Connecticut, on June 6, 1755. He had an athletic body and a calm, pious temperament. As a boy, he enjoyed taking part in sports competitions.

Hale also took advantage of opportunities for education. He prepared for college and learned the classics under the tutorship of Joseph Huntington, a clergyman. In 1769, Hale entered Yale College. After graduation in 1773, he taught school for a year at East Haddam, Connecticut. He then moved to New London, Connecticut.

The Revolutionary War. Although Hale was highly successful in his teaching, he was also deeply concerned about American rights. In July 1775, he received a lieutenant's commission from the Connecticut assembly and helped in the siege of Boston. When the British forces evacuated Boston and entered the New York area, Hale, along with other patriot soldiers, went there to meet the new threat. By this time, he had become a captain in the Continental Army. Hale's resourceful leadership, especially in capturing a supply-loaded vessel from under the guns of a British warship, won him a place in a select fighting group called the Rangers. The Rangers were known for their daring leadership and fighting qualities in dangerous missions.

The fateful mission. Unknown to Hale or anyone else, the time had come for a dramatic moment of the Revolutionary War. General George Washington asked the Rangers' commander to select a man to pass through the British lines to obtain information on the British position. The commander called for a volunteer. Hale agreed to undertake the mission.

Disguising himself in civilian clothes as a Dutch schoolmaster, Hale succeeded in crossing the British lines. He obtained the information that Washington requested. But as Hale returned to the American lines on Sept. 21, 1776, he was captured by the British. Many believe that Hale's cousin, an ardent British loyalist, betrayed him.

Hale was taken before General William Howe, the British commander. Howe saw that Hale was out of uniform and condemned him to hang the next day as a spy. With remarkable calmness of mind and spirit, Hale prepared for his execution. Before the hanging he made a speech. Historians are not sure what Hale really said. According to tradition, he ended his speech with the inspiring words, "I only regret that I have but one life to lose for my country."

There are several Hale monuments. A boulder marks *Halesite* near Huntington, New York, where it is be-

Chicago Historical Society

Captain Nathan Hale was executed in New York City near what is now 66th Street and Third Avenue. Major Cunningham, who stands facing Hale, denied his last request for a Bible and destroyed a letter Hale had written.

lieved Hale was captured. A Nathan Hale Homestead stands in South Coventry, Connecticut.

James Kirby Martin

Additional resources

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Darrow, Jane. *Nathan Hale: A Story of Loyalties.* Century Co., 1932. Suitable for younger readers.

Johnston, Henry P. *Nathan Hale, 1776: Biography and Memorials.* Rev. ed. Yale, 1914. A standard work.

Hale, Sarah Josepha, *joh SEE fuh* (1788-1879), became one of the most famous magazine editors in the United States during the 1800's. As editor of the *Ladies' Magazine* and, later, of *Godey's Lady's Book,* she helped shape the taste and thought of thousands of women. She received credit for persuading President Abraham Lincoln to make Thanksgiving a national holiday. Of her many writings, her major surviving work is the children's poem, "Mary Had a Little Lamb." Sarah Hale was born in Newport, New Hampshire. Michael Emery

Hale Observatories. See Palomar Observatory.

Haleakala National Park, *HAH leh AH kah LA,* became a separate park in 1961. It had been part of Hawaii Volcanoes National Park since 1916. Haleakala National Park lies on the island of Maui, in Hawaii. Its chief attraction, the dormant volcano Haleakala (*house of the sun*), has colorful rock formations in its crater. For the park's area, see **National Park System** (table: National parks).

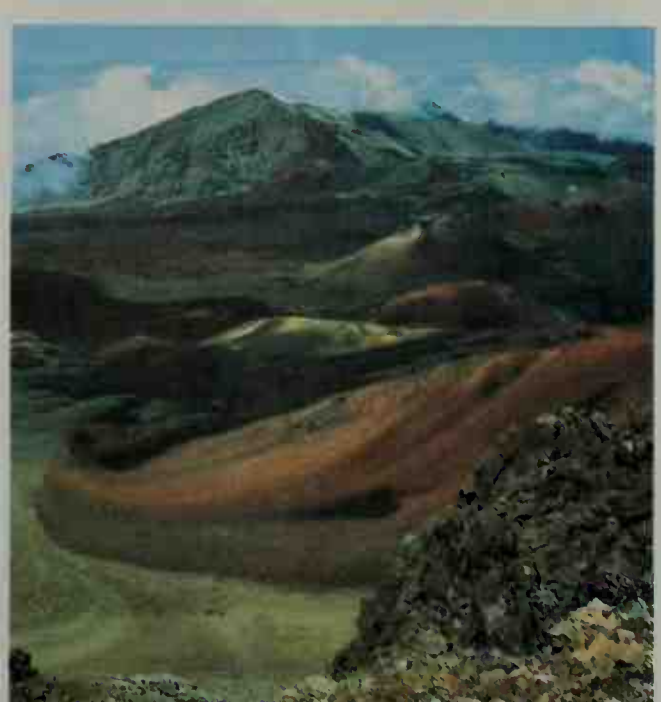
Critically reviewed by the National Park Service

Halevi, *hah LAY vee,* **Judah** (1085-1141?), was one of the greatest Hebrew poets of the Middle Ages. His poetry included both national and religious songs, and dealt with the suffering and hopes of the Jewish people. Many of his hymns to Zion (the land of Israel), called "Zionids," are still read in Jewish religious services. He was also a physician and a religious philosopher, His most important philosophical work was *Sefer ha-Kuzari,* or *al-Khazari,* an eloquent defense and profound explanation of Judaism. Halevi was born in Toledo, Spain.

Gary G. Porton

See also **Hebrew literature** (Medieval works).

Haley, Alex (1921-1992), was an American author who became famous for his book *Roots: The Saga of an American Family* (1976). In the book, Haley combined fact and fiction as he described the history of his family, beginning in the mid-1700's in Africa. *Roots* tells how Haley's ancestor Kunta Kinte was kidnapped in Gambia



Werner Stoy, Camera Hawaii

Haleakala National Park lies on the island of Maui in Hawaii. It features the crater of Haleakala, a dormant volcano, *above.*

in 1767 and taken to America as a slave. It follows the struggles of Haley's family in America as slaves and later as free people.

Warner Bros. Television Distribution, Inc.

Alex Haley

Haley spent 12 years researching *Roots*. His fame grew after an eight-part dramatization of *Roots* appeared on television in the United States in 1977. The final episode of the dramatization attracted one of the largest audiences in television history. That same year, Haley received the Spingarn Medal and a special citation from the Pulitzer Prize Board for his book.

Alex Palmer Haley was born on Aug. 11, 1921, in Ithaca, New York. He grew up in Henning, Tennessee, and other Southern communities. He served in the Coast Guard from 1939 to 1959 and began to write articles and short stories during that period. Haley edited *The Autobiography of Malcolm X* (1965). Edgar Allan Toppin

Half dollar is a United States coin worth 50 cents. The half dollar featuring President John F. Kennedy has been minted since February 1964. It has the presidential seal on the reverse side. This half dollar replaced the Franklin half dollar, which was first issued in 1948. In 1975 and 1976, the government issued special bicentennial half dollars. These coins featured Kennedy on one side and Independence Hall on the other.

The first half dollars were minted in 1794, along with the first silver dollars. Both coins had a portrait or figure of Liberty on one side and an eagle on the reverse.

WORLD BOOK photo by James Simek

The U.S. half dollar pictures President John F. Kennedy. The presidential seal appears on the coin's reverse side.

Until 1965, half dollars contained 90 percent silver and 10 percent copper. The Coinage Act of 1965 changed the ratio to 40 percent silver and 60 percent copper. A 1970 act eliminated all silver from the half dollar.

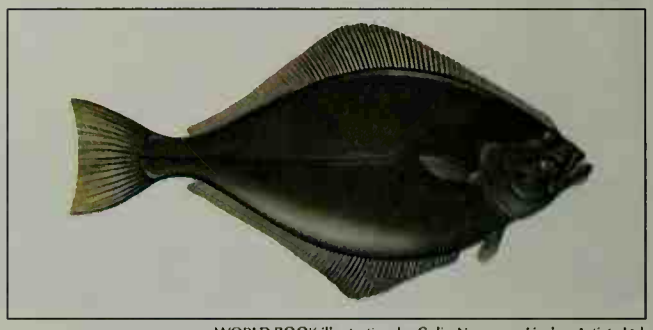
Burton H. Hobson

Halibut is one of the largest and most important of the flatfishes. Its name comes from the word *holy* and refers to the fact that it was once widely used as food on Christian holy days. A cold-water fish, the halibut belongs to the flounder group and has the characteristic flat body, with both eyes on the same side of the head. Its eyes lie on the right side, which is dark brown. The left side is white. Halibut can be found in all northern seas. They are among the largest of the world's true bony fishes. Some female halibut weigh as much as 400 pounds (180 kilograms).

Halibut are caught with strong hooks tied a short distance apart on long lines. The hooks are baited and then dropped to the ocean bottom. The most important fishing areas in North America are the waters from Puget Sound to Alaska, the Grand Banks off Newfoundland, and the waters of Greenland. Halibut flesh has a mild, pleasant flavor. Robert R. Rofen

Scientific classification. Halibut make up the family Hippoglossidae. The scientific name for the Atlantic halibut is *Hippoglossus hippoglossus*. The Greenland halibut is *Reinhardtius hippoglossoides*.

See also **Fish** (picture: Fish of coastal waters and the open ocean); **Fishing industry** (Fishery conservation); **Flatfish; Flounder.**



WORLD BOOK illustration by Colin Newman, Linden Artists Ltd.

The halibut is an important food fish that lives in northern waters. It has a flat body with both eyes on its right side.

Halifax is the capital of Nova Scotia. Halifax has one of the world's largest harbors. The harbor serves as Canada's main naval base and is the country's busiest east coast port. It remains open in winter when ice closes most other eastern Canadian ports. In 1996, the cities of Halifax and Dartmouth, the town of Bedford, and the rest of Halifax County were combined to form the Halifax Regional Municipality, with a single regional government. The 2001 census population of the Halifax Regional Municipality was 359,111. For location, see **Nova Scotia** (political map).

British settlers founded the town of Halifax in 1749. The United Kingdom built a military base there because of its growing struggle with France for control of North America. France had forces stationed at nearby Louisbourg (see **Louisbourg**). Halifax was named for George Dunk, the Earl of Halifax, who headed the government board that supervised the colony. Halifax is one of Canada's most historic locations. Canada's first representative government, the General Assembly of Nova Scotia, was established in Halifax in 1758. The first Protestant church in Canada was built there in 1749, and Canada's first newspaper appeared there in 1752.

Description. The Halifax Regional Municipality covers 2,120 square miles (5,491 square kilometers) surrounding Halifax Harbour. It includes the communities of Halifax, Dartmouth, and Bedford, as well as the area surrounding those communities. The community of Dartmouth lies north of the harbor. Most of the community of Halifax is on a peninsula between the harbor and an inlet called the North West Arm. Bedford is at the western end of the harbor. Two ferries and two suspen-

Halifax City Hall, completed in 1887, is a famous landmark. It stands in the downtown area of the community of Halifax. The modern office buildings in the background are part of the Scotia Square commercial center.

© Steve Elmore, The Stock Market

sion bridges across the harbor link the communities of Halifax, Dartmouth, and Bedford.

Province House, Canada's oldest parliament building, stands in the downtown area of the community of Halifax. This building, the home of the Nova Scotia legislature, was completed in 1818. The Citadel, a stone fortress built in 1828, overlooks the downtown area from a hilltop. York Redoubt, a defense post on the North West Arm, dates from 1793. The Prince of Wales Martello Tower, a fortification built in 1796, stands in Point Pleasant Park.

The economy of Halifax depends heavily on two military bases in the area—the CFB Halifax naval base and the CFB Shearwater air base. Large numbers of civilians and armed forces members work at these bases. The Port of Halifax handles about 15 million tons (14 million metric tons) of cargo annually. Halifax International Airport handles domestic and international flights.

Over 100 manufacturing plants operate in the Halifax area. Food processing and oil refining are the leading industries. Halifax also has growing aerospace, computer software, medical research, and telecommunications industries. Hospitals in Halifax form the largest Canadian medical center east of Quebec City.

The Halifax region's institutions of higher education include Dalhousie University, Mount St. Vincent University, Nova Scotia College of Art and Design, and St. Mary's University. The Bedford Institute and other research organizations in the area make up one of the largest centers of ocean study in the world.

The Dalhousie University Arts Centre offers art exhibits, concerts, and plays. Halifax has a resident theater group, a symphony orchestra, and a number of art galleries. Museums in the region include the Black Cultural Center, the Maritime Museum of the Atlantic, the Nova Scotia Museum of Natural History, and the Public Archives of Nova Scotia. Pier 21, a national immigration museum, is housed in a former immigration processing center on the waterfront.

Government and history. The Halifax Regional Municipality has a council-manager government. Voters elect a mayor and 23 councilors to the regional council. The council appoints a chief administrative officer to be the administrative head of the government. The region gets most of its revenue from property taxes.

Micmac Indians lived in what is now the Halifax area before white explorers arrived there. In 1749, the United Kingdom sent Governor Edward Cornwallis and about 2,500 settlers to establish a fort and town. The same year, Halifax became the capital of the colony of Nova Scotia.

Halifax served as a major British naval base during the Revolutionary War in America (1775-1783) and the War of 1812. Military officers governed the city until 1841. That year, Joseph Howe, a newspaper editor and statesman, led a campaign that brought the city incorporation and self-government. Halifax had 20,749 people in 1851. By 1901, its population had reached 40,832.

In 1917, during World War I, a French ammunition ship exploded in the city's harbor. This disaster killed about 2,000 people and wrecked much of Halifax. During World War II (1939-1945), Halifax became the chief North American base for Allied ships carrying food and war supplies to Europe.

During the 1960's and 1970's, downtown Halifax underwent redevelopment with the construction of the Scotia Square commercial center and a nearby sports complex and convention center. The Historic Properties and Purdy's Wharf developments transformed the waterfront with a mix of restored warehouses dating from the 1800's and modern offices, condominiums, and hotels. The waterfront was also designed to house the *Bluenose II,* a copy of the racing schooner represented on Canada's 10-cent coin.

Port operations boomed with the opening of the Halifax Container Terminal in 1970 and the Fairview Cove terminal in 1981. Cranes at the terminals quickly transfer large containers of cargo between ships and trains. This procedure makes shipment via Halifax one of the fastest freight routes between Europe and the central regions of Canada and the United States.

In 1971, drillers struck small oil deposits off Sable Island near the Nova Scotia coast. Halifax became a center of oil industry activity.

In 1994, Nova Scotia passed legislation to create the Halifax Regional Municipality, which would make all of Halifax County, including Halifax, Dartmouth, and Bedford, a regional municipality with a single regional government. A mayor and council were elected in December 1995, and the Halifax Regional Municipality came into being on April 1, 1996. Robert Howse

For the monthly weather in Halifax, see Nova Scotia (Climate). See also Nova Scotia (pictures).

Halite. See Salt.

Hall, G. Stanley (1844-1924), an American educator and psychologist, became an authority on the study of children. Hall was the first educator to apply results of child psychology experiments to teaching.

In 1889, Hall became the first president of Clark University in Worcester, Massachusetts. There he stimulated research in psychology. His writings include *The Contents of Children's Minds on Entering School* (1894), *The Story of a Sand Pile* (1897), *Adolescence* (1904), *Youth* (1907), and *Educational Problems* (1911). He also founded and edited the *American Journal of Psychology.*

Granville Stanley Hall was born on Feb. 1, 1844, in Ashfield, Massachusetts. He graduated from Williams College and then studied abroad. He was professor of psychology at Antioch College from 1872 to 1876. He lectured on psychology at Harvard University and Williams for a year. Hall was a professor at Johns Hopkins University from 1881 to 1888. In 1892, he became the first president of the American Psychological Association. David Hothersall

Hall, James N. See Nordhoff and Hall.

Hall, Lyman (1724-1790), an American Revolutionary War statesman, urged independence from Britain and influenced Georgia's decision to join the other colonies. He was a delegate to the Continental Congress and signed the Declaration of Independence.

Hall was born on April 12, 1724, in Wallingford, Connecticut. He studied for the ministry at Yale College. Later, he became a doctor and settled in Georgia. He was elected governor of Georgia in 1783. T. H. Breen

Hall, Prince (1748-1807), founded the first all-black Masonic lodge in America. Hall's lodge and other all-black lodges founded later made up the first major organization created by blacks in America.

Hall was born in the West Indies. He moved to the Boston area in 1765. He educated himself and became a property owner and a pastor of a Methodist congregation in Cambridge, Massachusetts. In 1775, Hall and 14 other free blacks joined an all-white British Army Masonic lodge in Boston. The blacks formed a separate "African Lodge" after the start of the Revolutionary War in America (1775-1783). Hall's group could not get an American Masonic charter, but it was chartered by English Masons in 1787. Richard Bardolph

Hall effect is an electrical phenomenon that occurs when a current flows through a material in a magnetic field. For example, if a material has a current flowing through it perpendicular to a magnetic field passing through the material, the Hall effect is observed as a voltage across the material. The Hall voltage is perpendicular to both the direction of the current and the direction of the magnetic field.

For any given material, the Hall voltage is proportional to the current and the magnetic field. Different materials produce different Hall voltages. Thus, scientists can use the Hall effect to describe the electrical properties of materials and to measure the magnetic fields or currents. For example, the Hall voltage produced in metals is much smaller than that produced in semiconductor materials. The Hall effect was discovered in 1879 by the American physicist Edwin H. Hall. Lynn W. Hart

Hall of fame is a museum honoring people who have gained fame in a particular field. One of the best-known halls of fame is the Hall of Fame for Great Americans in New York City. The National Baseball Hall of Fame and Museum, the Pro Football Hall of Fame, and other institutions pay tribute to great athletes. Halls of fame also honor achievements in a number of other fields.

The Hall of Fame for Great Americans is a memorial to Americans who have gained lasting fame for their great achievements. The building is a semicircular, covered, outdoor corridor, 630 feet (192 meters) long and a little over 10 feet (3 meters) wide. Between granite columns there are 102 spaces for bronze busts of persons elected to the Hall of Fame. Beneath each bust is a bronze tablet bearing the name, dates of birth and death, and a quotation from the honored person. The structure was designed by the American architect Stanford White about 1900.

The Hall of Fame for Great Americans was founded in 1900 by New York University. In 1974, the university transferred responsibility for the hall to a newly organized board of trustees. Elections were suspended indefinitely in 1977 because of a lack of money. But the Hall of Fame remained open to visitors. It is on the campus of Bronx Community College in New York City.

Sports halls of fame honor great athletes of the past. The National Baseball Hall of Fame and Museum in Cooperstown, New York, pays tribute to great baseball figures from the major and Negro leagues. See the Baseball article for a list of players in the baseball hall of fame. The College Football Hall of Fame in South Bend, Indiana, honors outstanding college players and coaches. The Pro Football Hall of Fame in Canton, Ohio, is dedicated to athletes, coaches, and others who helped develop and promote professional football. The Naismith Memorial Basketball Hall of Fame in Springfield, Massachusetts, pays tribute to players, coaches, and others who had a major impact on professional, college, or high school basketball. The Hockey Hall of Fame in Toronto honors players and other individuals who made important contributions to the sport. Bowling, boxing, golf, skiing, and tennis organizations also elect top-ranking players to their halls of fame.

Other halls of fame honor people in professional and other groups. The Hall of Immortals in the International College of Surgeons in Chicago honors great surgeons and scientists. The Agricultural Hall of Fame in

Members of the Hall of Fame for Great Americans

1900

George Washington
Abraham Lincoln
Daniel Webster
Benjamin Franklin
Ulysses S. Grant
John Marshall
Thomas Jefferson
Ralph Waldo Emerson
Robert Fulton
Henry Wadsworth Longfellow
Washington Irving
Jonathan Edwards
Samuel F. B. Morse
David G. Farragut
Henry Clay
Nathaniel Hawthorne
George Peabody
Peter Cooper
Robert E. Lee
Eli Whitney
John James Audubon
Horace Mann
Henry Ward Beecher
James Kent
Joseph Story
John Adams
William Ellery Channing
Gilbert Stuart
Asa Gray

1905

John Quincy Adams
James Russell Lowell
William T. Sherman
Emma Willard
Mary Lyon
James Madison
John Greenleaf Whittier
Maria Mitchell

1910

Harriet Beecher Stowe
Oliver Wendell Holmes
Edgar Allan Poe
James Fenimore Cooper
Phillips Brooks
William Cullen Bryant
Frances E. Willard
Andrew Jackson
George Bancroft
John Lothrop Motley

1915

Mark Hopkins
Francis Parkman
Elias Howe
Joseph Henry
Louis Agassiz
Charlotte Cushman
Rufus Choate
Daniel Boone
Alexander Hamilton

1920

Mark Twain
James B. Eads
William T. G. Morton
Augustus Saint-Gaudens
Patrick Henry
Roger Williams
Alice Freeman Palmer

1925

Edwin Booth
John Paul Jones

1930

Walt Whitman
Matthew F. Maury
James A. McNeill Whistler
James Monroe

1935

William Penn
Simon Newcomb
Grover Cleveland

1940

Stephen Foster

1945

Booker T. Washington
Sidney Lanier
Thomas Paine
Walter Reed

1950

Woodrow Wilson
Alexander Graham Bell
Susan B. Anthony
William C. Gorgas
Theodore Roosevelt
Josiah W. Gibbs

1955

Wilbur Wright
Stonewall Jackson
George Westinghouse

1960

Thomas Alva Edison
Henry David Thoreau
Edward MacDowell

1965

Jane Addams
Oliver Wendell Holmes, Jr.
Sylvanus Thayer
Orville Wright

1970

Albert Abraham Michelson
Lillian D. Wald

1973

George Washington Carver
Louis D. Brandeis
Franklin D. Roosevelt
John Philip Sousa

1976

Clara Barton
Luther Burbank
Andrew Carnegie

Bronx Community College

The Hall of Fame for Great Americans, in New York City, recognizes Americans who have earned lasting fame for their achievements. The building houses bronze busts and tablets honoring its members. The structure was designed by the American architect Stanford White about 1900.

© Nik Wheeler, Corbis

Sports halls of fame pay tribute to great athletes. The National Baseball Hall of Fame and Museum in Cooperstown, New York, honors players and other individuals who made outstanding contributions to the sport.

Bonner Springs, Kansas, honors those who have contributed significantly to farming. The National Hall of Fame for Famous American Indians is in Anadarko, Oklahoma. The National Cowboy & Western Heritage Museum in Oklahoma City, Oklahoma, houses the Rodeo Hall of Fame, the Hall of Great Westerners, and the Hall of Great Western Performers. The National Black Sports and Entertainment Hall of Fame is in New York City. The National Women's Hall of Fame is in Seneca Falls, New York. The International Space Hall of Fame is in Alamogordo, New Mexico. Ralph Martin Rourke

See also Michigan (Places to visit [National Ski Hall of Fame]).

Halleck, Henry Wager, *HAL ihk, HEHN ree WAY juhr* (1815-1872), was a Union general in the American Civil War. He served without distinction as general in chief of the Union Army from 1862 to 1864.

Halleck was born on Jan. 16, 1815, in Westernville, New York, near Rome. He graduated from the U.S. Military Academy. During the Civil War, Halleck's first major command was in the Department of the Missouri, a military area that included Missouri, Arkansas, Iowa, Illinois, and Minnesota. As general in chief, he failed to develop the imaginative, aggressive strategy President Abraham Lincoln desired. Lincoln replaced him with General Ulysses S. Grant in 1864. Halleck became Army chief of staff.

Halleck also was a military scholar. He wrote several books on war and became known as "Old Brains."

Gabor S. Boritt

Halley, *HAL ee,* **Edmond** (1656-1742), also spelled Edmund, was an English astronomer noted for his work on comets. He calculated the orbit of a comet he observed in 1682 and proved that it was the same one astronomers had seen in 1531 and in 1607. He predicted its return in 1758. The comet was sighted on Christmas Day of that year. This comet became known as Halley's Comet. See Halley's Comet.

Halley produced the first accurate map of the stars visible from the Southern Hemisphere. He proved that stars have *proper motion*—that is, they change position in relation to each other. Halley studied the orbit of the moon and the effect of the moon on ocean tides. He also determined an accurate way to measure the distance of the sun from the earth. This measurement was needed for determining the size of the solar system and the distances of other stars from the earth.

Halley was born on Nov. 8, 1656, in London. He attended Oxford University and served as England's astronomer royal from 1720 until his death. C. R. O'Dell

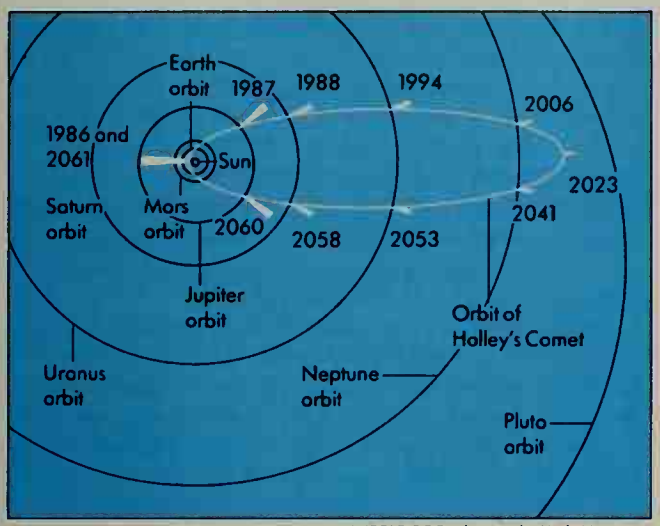
See also Map (Advances in European cartography).

Halley's Comet, *HAL eez,* is a brilliant comet named for the English astronomer Edmond Halley, who studied the paths of comets. Before Halley made his investigations, most people believed that comets appeared by chance and traveled through space in no set path.

Halley found that the paths of certain comets seen in 1531 and 1607 were identical with the path of a comet observed in 1682. He concluded that all the observations were of a single comet traveling in a set orbit around the sun. Halley predicted that the comet would reappear in 1758 and at fairly regular intervals thereafter. The comet was indeed seen in 1758. Halley's Comet appears about every 76 years. The first reported sightings were made by Chinese astronomers about 240 B.C.

Halley's Comet can be seen in its orbit only as it nears the sun. In August 1909, scientists at Helwan Observatory in Egypt photographed the comet when it was about 300 million miles (480 million kilometers) from the sun. On April 24, 1910, it came as close as 55 million miles (89 million kilometers) to the sun. On May 21, 1910, the earth is believed to have passed through the comet's tail.

On Oct. 16, 1982, astronomers at the Palomar Observatory in California made the next sighting of Halley's Comet. They photographed the comet when it was about 1 billion miles (1.6 billion kilometers) from the sun. The comet made its closest approach to the sun on Feb. 9, 1986. In March of that year, a number of space probes drew near the comet and collected information about its composition and the size of its *nucleus* (center). The Giotto, launched by the European Space Agency, made the closest approach, coming within about 370 miles



WORLD BOOK diagram by Linda Kinnaman

A comet travels through the solar system in a long, narrow orbit. The orbit of Halley's Comet, shown in this diagram, crossed the orbit of the earth in 1986, and astronomers predict that it will do so again in 2061.

(600 kilometers) of the comet's nucleus.

In 1991, astronomers observed Halley's Comet surrounded by a huge cloud of dust. Most astronomers believe the cloud was caused by a pocket of frozen gas, such as carbon monoxide, under the comet's crust. The gas vaporized and built up pressure until it burst through the crust, releasing the dust cloud.

The earth passes through the orbit of Halley's Comet each May and October. Dust left behind by the comet enters the earth's atmosphere and burns, producing meteor showers during these months. Lee J. Rickard

See also **Comet; Halley, Edmond.**

Additional resources

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Vogt, Gregory. *Halley's Comet: What We've Learned.* Watts, 1987.

Halliburton, Richard (1900-1939), was an American adventurer, author, and lecturer. He visited many parts of the world and wrote excitingly about his trips. Halliburton's daring got him into dangerous situations that give suspense to his books. His deep knowledge of history helped him relive the lives of leading historical figures in many countries.

Halliburton's writings include *The Glorious Adventure* (1927), *New Worlds to Conquer* (1929), *The Flying Carpet* (1932), *Seven League Boots* (1935), and *Richard Halliburton's Complete Book of Marvels* (1937).

Halliburton was born on Jan. 9, 1900, in Brownsville, Tennessee. He graduated from Princeton University. In 1939, he tried to cross the Pacific Ocean in a specially built Chinese junk. The junk was caught in a storm, and everyone on board was lost. Frank Goodwyn

Halloween is a popular holiday that takes place on October 31. In the United States and Canada, children dress in costumes and go trick-or-treating. Many people carve jack-o'-lanterns out of pumpkins. Halloween parties for children feature fortunetelling, mock haunted houses, scary stories, and games, such as bobbing for apples. People decorate their houses and yards with images of ghosts, skeletons, witches, black cats, bats, and other symbols of Halloween. Many communities across the United States also hold parades and other celebrations for Halloween.

Halloween developed from an ancient pagan festival celebrated by Celtic people over 2,000 years ago in the area that is now the United Kingdom, Ireland, and northwestern France. The festival was called *Samhain* (pronounced *SOW ehn*), which means *summer's end.* The festival marked the start of the dark winter season and was celebrated around November 1. In the A.D. 700's to 800's, the Christian church established a new holiday, All Saints' Day, on this date. All Saints' Day was also called All Hallows'. *Hallow* means *saint,* or *one who is holy.* The evening before All Hallows' was known as All Hallows' Eve, or as it came to be abbreviated, All Hallow e'en. This name was eventually shortened to Halloween.

Halloween customs and symbols

Trick-or-treating. It was once common for people to leave food out on a table as a treat for spirits believed to be about on Halloween. In England, people went house-to-house *souling*—that is, asking for small breads called *soul cakes* in exchange for prayers. In some areas of the United Kingdom and Ireland, people went *mumming* (parading in masks) on Halloween. Groups of masked adults would go door-to-door asking for food and drink in return for a performance or song. Dressing in costume and asking for food or money was done in England on Guy Fawkes Day (November 5).

Today, trick-or-treating is the main Halloween activity for children in the United States and Canada. Young people wear costumes and go from door to door saying "trick or treat!" Costumes range from simple homemade disguises to elaborate store-bought likenesses of char-

© Corbis/Bettmann

Richard Halliburton, shown here with two unidentified women about 1933, was an American adventurer. He circled the globe by airplane and visited the world's most romantic regions.

© Ariel Skelley, Corbis Stock Market

Trick-or-treating is the main Halloween activity for children in the United States and Canada. Children dress in costumes and go door-to-door collecting candy and other treats.

acters from cartoons, motion pictures, and television. Costumes of ghosts, witches, devils, and other mysterious creatures are also popular. The neighbors, to avoid having tricks played on them, give the children candy and other treats. Children carry bags or plastic buckets to collect the candy. Trick-or-treating usually occurs late in the day or after dark on Halloween. Homeowners turn on their porch lights as a sign that treats are available.

Since 1950, some children have gone trick-or-treating for UNICEF, the United Nations Children's Fund. They collect money for the agency in official orange-and-black cartons to aid children throughout the world.

Certain measures can help prevent accidents while trick-or-treating. A child can wear a light-colored costume or one with reflecting tape sewn on so they can be easily seen by drivers. The costume should be made of a material that does not burn easily. Because masks can block vision, many parents of small children use face makeup instead. Children should visit only homes in their own neighborhood. Younger trick-or-treaters should be accompanied by an adult.

Costumes. Adults sometimes wore costumes when they begged house-to-house for a Halloween feast. In County Cork, Ireland, a man wearing a white robe and holding a wooden horse's head led the group. In parts of Scotland, costumed beggars out on Halloween were known as *skeklets.* In Wales, boys dressed as girls and girls dressed as boys to go house-to-house singing Halloween rhymes.

Halloween costumes were popularized in the United States by adults in the late 1800's. By the early 1900's, however, Halloween costumes were worn mainly by children. Some of the first children's costumes were fairies, gypsies, and burglars. In the 1950's, factory-made costumes of popular figures from movies and television appeared. Store-bought costumes have since become popular among both children and adults.

Jack-o'-lanterns are hollowed out pumpkins with a face cut into one side. Most jack-o'-lanterns contain a candle or some other light. People in Scotland and Ireland once carved out large beets or turnips to use as lanterns on Halloween. After this custom reached America, pumpkins began to be used. The jack-o'-lantern originally represented spirits present in the dark, or souls released from Christian purgatory.

According to an Irish legend, jack-o'-lanterns were named for a character named Jack, who could not enter heaven because he was a miserly, bad-tempered man. He could not enter hell either, because he had tricked the devil several times. As a result, Jack had to walk the earth forever with only a coal from hell to light his lantern.

Fortunetelling methods that developed in Europe hundreds of years ago became an important part of Halloween rituals and celebrations. In Ireland, objects, such as a coin, a ring, and a thimble, were baked into a cake or other food. It was believed that the person who found the coin would become wealthy. Whoever found the ring would marry soon, but the person who got the thimble would never get married.

Halloween magic is also associated with foods, such as apples and nuts. In one fortunetelling game, a young woman would peel an apple in one long paring and throw it over her shoulder. People believed it would land in the shape of the initial of the man the woman would marry. Halloween's connection with apples and nuts is ancient, and Halloween was sometimes referred to as Nutcrack Night or Snap Apple Night. Today, some people use fortunetelling techniques, such as tarot cards or palm reading, to predict the future on Halloween.

Mischief Night. The night before Halloween is known by a number of names, including Mischief Night and Devil's Night. This is a night when young people play tricks on their neighbors, such as decorating trees with tissue paper or soaping windows. But through the years, Mischief Night pranks, which had usually been harmless, sometimes became rowdy and destructive. As a result, many communities now discourage Mischief Night activities.

Halloween symbols. In the 1500's and 1600's, people in Europe believed that the devil made witches do evil deeds. Over the centuries, people came to imagine that witches—and sometimes their animal companions, often black cats—rode through the night sky on Halloween. Throughout the ages, superstitious folk thought that fairies and ghosts could be asked for help casting spells or seeing into the future on Halloween. These supernatural creatures were not always friendly, and people sometimes carried turnip lanterns carved with grotesque faces to keep them away. In Scotland, people

lit huge bonfires on hillsides to drive away evil spirits. For centuries in Europe, people remembered the dead at All Saints' Day and All Souls' Day (November 2) with bonfires. Although bonfires are less common on Halloween today, people still mark the night with candles burning in jack-o'-lanterns. In addition, although most people do not believe in ghosts or witches, these supernatural beings remain symbols of Halloween.

Halloween around the world

For centuries, Halloween was marked throughout much of the United Kingdom and Ireland as a family celebration. People ate traditional foods including cabbages, apples, potatoes, nuts, and oats. Games, fortunetelling, disguises, and tricks are all part of Halloween celebrations in much of England, Ireland, Scotland, and Wales. The American custom of trick-or-treating has also become popular in many areas. In the United Kingdom, children ask, "Anything for Halloween?" rather than demand, "trick or treat!" Fireworks are a part of many Halloween celebrations in Ireland and Canada.

In many countries in Europe, people visit the graves of loved ones on All Saints' or All Souls' Day. Recently, however, American Halloween traditions, such as trick-or-treating, are now practiced alongside this custom. Halloween parties for adults have also become popular in many European cities. American-style Halloween customs are also appearing in Australia and New Zealand. Many nightclubs and hotels in some large Asian cities use Halloween parties to entertain foreign tourists.

American-style Halloween celebrations are not welcomed everywhere, however. For example, Halloween is often regarded with suspicion in China. In Mexico, *Día de los muertos* (Day of the dead) is usually celebrated in November with special foods and visits to family gravesites. It is often mistaken for Mexican Halloween. Actually, the celebration is a unique blend of ancient Native American beliefs and Spanish Catholic traditions. Some people in other countries, including Italy and Poland, view Halloween as an American import that has nothing to do with their own culture, and urge children to celebrate their native holidays.

History

Samhain. Scholars know little about ancient Celtic religious rituals, festivals, and celebrations. Many believe the festival of Samhain to be the beginning of the Celtic year. At Samhain, farmers brought livestock in from summer pastures, and people gathered to build shelter for the coming winter. During this time of reunion, new laws were made, stories were told, and they celebrated the season with bonfires and feasting. The festival also had religious significance and people burned fruits, vegetables, grain, and possibly animals as offerings to the gods.

In ancient Celtic stories, Samhain was a magical time of transition when important battles were fought and fairies cast spells. It was a time when the barriers between the natural world and the supernatural were broken. The Celts believed that the dead could walk among the living at this time. During Samhain, the living could visit with the dead, who they believed held secrets of the future. Scholars believe that Halloween's association with ghosts, food, and fortunetelling began with these pagan customs more than 2,000 years ago.

All Saints' and All Souls' Day. Many of the customs of the pagan Celts survived even after the people became Christians. In the A.D. 700's to 800's, Christians in Western Europe began to celebrate All Saints' Day on November 1. About two hundred years later, the Christian church established All Souls' Day on November 2. This day was set aside for people to pray for friends and family who had died. People made many of the old pagan customs part of this Christian holy day. Some people put out food for their ancestors, or they left a lantern burning in the window so that ghosts could find their way home for the night.

Through the years, various regions of Europe developed their own Halloween customs. In Wales, for example, each person put a white stone near the Halloween fire at night and then checked in the morning to see whether the stone was still there. If it was, the person would live another year.

Halloween in the United States. Many early American settlers came from England, and they brought various beliefs about ghosts and witches with them. In the 1800's, many immigrants from Ireland and Scotland arrived in the United States and introduced their Halloween traditions. Other groups added their own cultural influences to Halloween customs. German immigrants brought a vivid witchcraft lore, and Haitian and African peoples brought their native voodoo beliefs about black cats, fire, and witchcraft.

By the end of the 1800's, the United States had developed a variety of regional Halloween customs. In rural New Hampshire, for example, barn dances were a Halloween tradition. In New York City, Halloween parades and firecrackers were common aspects of the celebration. In the mountain regions of North Carolina, it was said that Halloween was a time when people could hear the future whispered in the wind. In Louisiana, it was time to cook a midnight *dumb supper* (a meal eaten without speaking) and watch for a ghost to join the table.

In the 1900's, Halloween became a celebration for children more than adults. In the early 1900's, towns and cities began hosting large community Halloween celebrations, parades, and parties. Trick-or-treating became widespread during the 1940's and 1950's.

By the late 1900's, Halloween had become one of the most profitable holidays for American business. In the weeks before Halloween, stores sell decorations, costumes, masks, candy, and cards. Many people decorate their houses with jack-o'-lanterns, cornstalks, fake cobwebs, tombstones, and other Halloween symbols.

Halloween celebrations among adults have also become increasingly popular. Many adults wear a costume to work on Halloween. Others attend private costume parties or Halloween events held at nightclubs, hotels, or restaurants. New York City and other cities across the United States hold extravagant Halloween costume parades in which thousands of people participate. Many cities provide Halloween entertainments for families at parks, zoos, and amusement parks. Many private and civic organizations create mock haunted houses for entertainment and to raise money for charity.

Lesley P. Bannatyne

See also All Saints' Day; Día de los muertos.

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Hallucination, *huh LOO suh NAY shuhn,* is a mental state in which a person sees, hears, tastes, smells, or feels something that is not present. Hallucinations may indicate the presence of a mental or physical disorder. But normal people also may hear voices or see visions when deprived of stimuli, such as in solitary confinement or when under the influence of drugs.

Allen Frances

See also Mental illness (Schizophrenia).

Hallucinogenic drug, *huh LOO suh nuh JEHN ihk,* is any of several substances that distort perception of oneself and one's surroundings. These drugs temporarily change the chemistry of the brain. Also called *psychedelic* (mind-revealing) drugs, hallucinogenic drugs affect the senses, emotions, reasoning, and the brain's control of muscles and certain body functions. The changes may be extremely pleasant or highly unpleasant and frightening. In the United States, laws prohibit the manufacture, distribution, and possession of these drugs, except for government-approved research and certain American Indian religious rituals.

Hallucinogenic drugs include naturally occurring drugs, such as *mescaline,* which is produced by the peyote cactus, and chemically manufactured substances, such as *DMT, PCP,* and *LSD.* PCP, also known as "angel dust," "crystal," or "embalming fluid," is an especially dangerous drug. It was developed in the 1950's and originally used as an anesthetic for animals. PCP later was discovered to produce an intensely euphoric state of mind in human beings. But PCP also may cause violent and impulsive behavior in some users.

Ecstasy, also known as *MDMA,* is a mind-altering drug with hallucinogenic and stimulant properties. Taken in pill form, it is commonly used at large, all-night dance parties known as *raves.* The drug produces feelings of relaxation, decreased anxiety, and heightened senses. Ecstasy can also cause confusion, depression, sleep problems, anxiety, and paranoia.

The effects of hallucinogenic drugs are sometimes called *trips.* During a trip, a drug user may see bright, moving colors. The user may *hallucinate* (see or hear things that are not present). The size, shape, or color of objects may appear to change constantly. In some cases, the user may do something reckless, not realizing the danger of being hurt or even killed. The user may have a sense of overwhelming fear, sadness, and horror or may feel intense love and joy.

The experience and effect of each trip can be influenced by (1) the type and amount of drug taken, (2) the circumstances in which the drug is used, and (3) the user's personality and mood. Hallucinogenic drugs are not addictive, but some people may develop a psychological dependence on them.

The effects of hallucinogenic drugs last from one hour to several days. But these effects may appear again months later as a *flashback.* Heavy, repeated use of hallucinogens can cause long-lasting disturbances in perception. This condition, called *post-hallucinogenic perceptual disorder,* can last for months after discontinuing use of the drug.

Paula DeGraffenreid Riggs

See also **Drug abuse; Ecstasy; LSD; Mescaline.**

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Halo is a luminous ring or a disk of light that surrounds an object. Halos commonly appear in Christian religious art as a symbol of saintliness or divinity. In many religious paintings created since the 400's, Jesus Christ and the Virgin Mary, as well as the angels and saints, have been portrayed with a shining circle around the head. The golden or jeweled crowns worn by royalty were originally modeled after the sacred halo. Such a crown was meant to signify the wearer's "divine right" to rule.

The term *halo* is also used in connection with various natural phenomena. The pale ring of light that occasionally appears around the sun or moon is called a halo. Such rings are most often seen during winter. They appear when light rays are *refracted* (bent) by ice crystals in the earth's upper atmosphere.

Robert Greenler, Sky Photos

A solar halo looks like a ring of light around the sun, shown here. It appears when light rays from the sun are bent by ice crystals in the earth's upper atmosphere.

Another type of halo is the sphere of stars that surrounds a spiral or elliptical galaxy (see **Galaxy**). This *galactic halo* consists of older stars containing few elements heavier than hydrogen and helium. This type of halo may extend hundreds of thousands of light-years from the center of a galaxy. Astronomers also speak of a halo of comets surrounding the solar system. These comets all orbit the sun at a distance of about 9.3 trillion miles (15 trillion kilometers). Many of the comets themselves are enveloped by a halo made of hydrogen gas. This halo forms when a comet travels close enough to the sun for the frozen methane and ammonia in the comet's head to change directly into gas. Thomas E. Lutz

Halogen, *HAL uh juhn.* The halogens are the chemical elements astatine (chemical symbol, At), fluorine (F), chlorine (Cl), bromine (Br), and iodine (I). They are nonmetals, and make up part of the seventh main group in the periodic system of the elements. *Halogen* means *salt producer.* Many of the salts in the sea are compounds of halogens with metals. Common table salt, the best known such compound, is sodium chloride.

The halogens all have a strong, unpleasant odor, and will burn the flesh. They do not dissolve well in water. At ordinary temperatures, fluorine is a pale yellow gas, chlorine a yellowish-green gas, bromine a red liquid, and iodine a black solid. Fluorine is the lightest halogen; astatine is the heaviest. The atomic weight of fluorine is 18.9984; of chlorine, 35.453; of bromine, 79.909; of iodine, 126.905; and of astatine, 210.

The five elements of the halogen group are electronegative. This means that the atoms of halogens tend to *oxidize* (take up electrons from) other chemicals and become charged with negative electricity. They are then called *negative ions.* The salts, called the *halides,* are compounds formed by these ions. All the halogens are oxidizing agents. However, the heavier the atomic weight of the halogen, the weaker its oxidizing power. Fluorine is the strongest of all oxidizing agents. It is also extremely reactive.

The halogens react with most metals and many nonmetals. Their reactions with hydrogen give the hydrogen halides. The most important of these is hydrogen chloride, which dissolves in water to make hydrochloric acid.

The halogens and their compounds have many uses. Iodine and bromine gases inside halogen light bulbs make the bulb last longer than an ordinary bulb and prevent it from blackening. Fluorides are used to make aluminum, steel, and the nonstick plastic Teflon. Small quantities of fluorides are added to toothpastes and drinking water to help prevent tooth decay. Chlorine and its compounds are important in making paper and plastics, and in purifying drinking water. Bromine is used to make dyes, fire-retardant chemicals, and medicines. The iodine compound silver iodide is used in photographic film. Other iodine compounds are valuable antiseptics and disinfectants. Astatine also has important medical uses. Evan H. Appelman

See also **Astatine; Bromine; Chlorine; Fluorine; Iodine.**

Halothane, *HAL uh thayn,* is a drug doctors use to make patients insensitive to pain during surgery. It is a *general anesthetic*—that is, it produces unconsciousness and loss of feeling throughout the entire body.

Halothane is a clear, colorless liquid that gives off pleasant-smelling, nonirritating vapors. Halothane vapor is nonflammable. Halothane therefore poses no risk of fire or explosion when used in the presence of electrical medical equipment. Patients who have received halothane regain consciousness rapidly.

Halothane is usually administered along with other drugs. Doctors often bring about anesthesia with an injection of thiopental, a barbiturate. Halothane is then administered to maintain anesthesia during surgery. Patients inhale the halothane vapor, usually in combination either with oxygen or with a mixture of oxygen and nitrous oxide. In many cases, drugs that provide additional muscle relaxation are also administered.

Halothane was discovered in England in 1951 and was first used in surgery in 1956 in the United States. Since then, halothane has become extremely popular. It has replaced ether as the standard by which other inhaled anesthetics are judged. Halothane's chemical formula is $F_3C\text{-}CHBrCl$. Its trade name is *Fluothane.*

The discovery of halothane led to the search for other safe and effective anesthetics that contain halogens (see **Halogen**). Of the hundreds of such compounds that have been found and studied, only two—enflurane and isoflurane—have emerged as useful agents for producing anesthesia. Edwin S. Munson

See also **Ether; Nitrous oxide.**

Hals, *hahls,* **Frans,** *frahns* (1580?-1666), was one of the finest Dutch portrait painters of the 1600's. His portraits are known for showing lively expressions and poses. In his group portraits, the expressions and poses are coor-

Oil painting on canvas (1623); The Metropolitan Museum of Art, New York City; bequest of Benjamin Altman

Frans Hals's *Yonker Ramp and His Sweetheart* shows the smiling, healthy people who made the Dutch painter famous. Hals was known for his ability to portray lively expressions.

dinated to maintain the balance of the composition. He painted with bold, broad brushstrokes.

Hals used several kinds of subjects for his portraits, including individuals and married couples. He painted group portraits of *civic guards* (social organizations for men) and leaders of social welfare organizations. One of these paintings, *Banquet of Officers of the Civic Guard of Saint George at Haarlem* (1616), appears in the **Painting** article. Before 1640, in addition to formal portraits, Hals frequently painted half-lengths of children and the colorful types of characters he may have met at inns. These paintings probably have symbolic or allegorical meanings.

Hals was born in Antwerp, Belgium. He spent most of his life in Haarlem, the Netherlands, where his parents moved to escape Spanish rule. See also **Descartes, René** (picture). Linda Stone-Ferrier

Halsey, *HAWL zee,* **William Frederick, Jr.** (1882-1959), was one of the leading United States naval commanders in World War II. General Douglas MacArthur called him "the greatest fighting admiral" of the war.

Halsey became vice-admiral in command of a Pacific carrier division in 1940. He commanded this division in attacks on the Gilbert and Marshall islands and on Wake Island and Marcus Island in February 1942. Later in 1942, he took command of U.S. naval forces in the South Pacific. In a series of bloody battles, his forces defeated the Japanese in the Solomon Islands. This victory enabled American land forces to occupy the entire island chain. During this period, Halsey also supported the opening offensives of General MacArthur in the Southwest Pacific. Halsey took command of the Third Fleet on June 15, 1944. In the Battle of Leyte Gulf in October 1944, Halsey's fleet and Admiral Thomas Kincaid's Seventh Fleet smashed the Japanese Navy and virtually eliminated it from the war.

The Japanese later signed the surrender on Halsey's flagship, the battleship *Missouri.* Halsey was born in Elizabeth, New Jersey, and was graduated from the U.S. Naval Academy in 1904. Donald W. Mitchell

See also **World War II** (The South Pacific; The liberation of the Philippines).

Ham, son of Noah. See **Noah.**

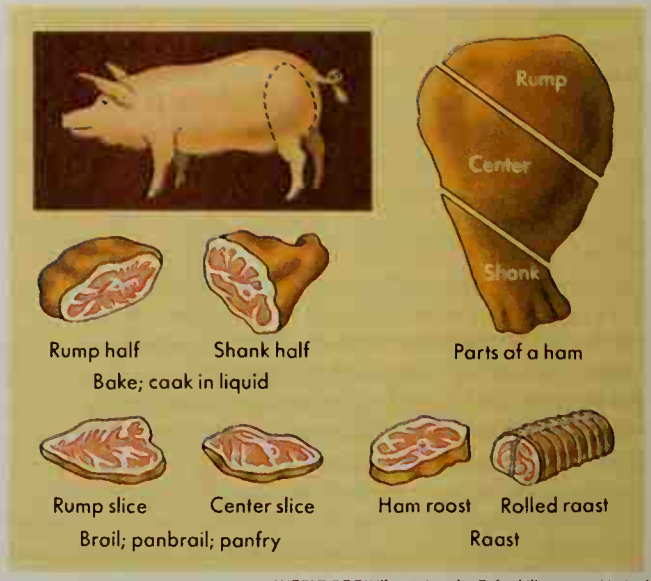
Ham. See **Radio, Amateur.**

Ham is the meat taken from the hind leg of a hog. Ham is an important food product. It is an excellent source of protein. It is also high in thiamine, iron, and other vitamins and minerals.

People serve ham in a wide variety of ways, including as a main dish, mixed into salads, on sandwiches, and in spreads. The ways to prepare ham include broiling, roasting, and frying. Some ham comes fully cooked and can be sliced and eaten without reheating.

Kinds of ham. Ham is sold as a whole leg or cut into smaller portions. The chief types of cuts are called *rump cuts, shank cuts,* and *center cuts.* The names refer to the part of the leg from which a cut is taken. Rump cuts come from the upper part of the leg. Shank cuts come from the lower part of the leg. Center cuts are carved from the center of the leg.

Ham is sold also in unprocessed and processed forms. The processed form is the kind most commonly referred to as ham. Fresh ham, usually called *pork leg,* is an unprocessed, lean meat that has a delicious pork flavor when cooked. It spoils quickly and must be cooked or stored in a freezer soon after purchase.



WORLD BOOK illustrations by Oxford Illustrators Limited

Cuts of ham include those shown above. There are many ways to prepare the various cuts of ham, including baking, broiling, frying, and roasting. Some ham is sold cooked and ready to eat.

Ham producers process ham by curing and smoking it. Ham prepared using either or both of these methods may be stored for several weeks or months without spoiling. Cured and smoked ham generally has a salty or sweet flavor and a smoky aroma.

Curing and smoking. Ham is cured using such ingredients as salt, sodium ascorbate, sodium nitrite, sodium phosphate, and sugar. Producers usually dissolve these ingredients in water to form a *curing brine.* They pump some of the brine into the ham. They then soak the ham in the remaining brine for three to seven days. Ham cured in this manner includes canned ham and Scotch-style ham. Producers cure some types of ham by rubbing them on the outside with dry curing ingredients. Such ham includes dry-cured ham, country ham, and country-style ham. These kinds of ham do not require refrigeration for storage, but must be soaked in water before they can be cooked and eaten.

Most cured ham is also smoked. Producers begin the smoking process by placing the ham in a large, walk-in oven called a *smokehouse* for cooking. They then create smoke by burning sawdust in a separate stove called a *smoke generator.* While the ham is cooking, fans blow the smoke from the smoke generator into the smokehouse. The smoke adds flavor to the ham. It also turns the ham a golden brown on the outside. Cooking causes chemical reactions to occur in the curing ingredients. These reactions make the meat turn pink.

Donald H. Beermann

See also **Meat; Meat packing; Pork.**

Hamadryas. See **Baboon.**

Hamburg (pop. 1,652,363) is Germany's second largest city and its most important industrial center. It is one of the largest seaports on the European continent.

Hamburg lies on the Elbe River, about 68 miles (110 kilometers) from the river's mouth on the North Sea (see **Germany** [political map]). The Alster River flows through Hamburg and forms two large lakes in the city. These

lakes are called the Binnen-alster and the Aussen-alster. Many narrow canals crisscross the city.

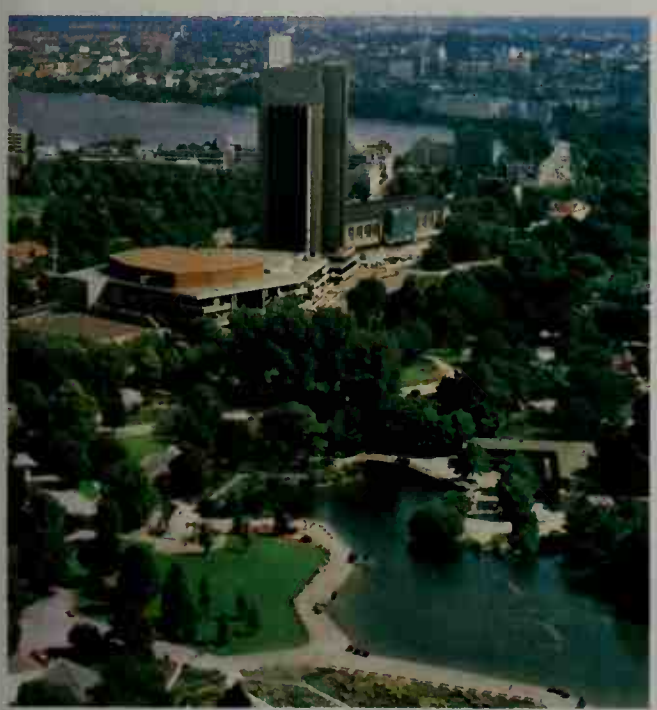
The city today. Hamburg was one of the most heavily bombed German cities during World War II (1939-1945). Incendiary bombs caused huge fires. Large parts of the city's port and commercial areas were wiped out and many old churches and fine homes were badly damaged or destroyed. But the port and commercial areas have been rebuilt since the war. The *Rathaus* (town hall), the new opera house, and many modern buildings give Hamburg an attractive appearance. The Hagenbeck zoo, the University of Hamburg (founded in 1919), and many museums are located there. The city is a center of political and cultural activities.

Hamburg's industries include chemical plants, ironworks, steelworks, and sawmills. They process many raw materials such as farm products, ores and metals, wood, and wood pulp. Shipbuilding has been an important industry for many years. The city's food industry processes cereals, coffee, meat, fish, and tobacco.

The harbor, which stretches along the Elbe, is the hub of Hamburg's economic activities. It is a center for foreign and inland shipping. Many of Germany's industrial products, which include automobiles, machinery, and optical goods, are exported from Hamburg. Hamburg's imports include such products as fruit, coffee, paper, and tobacco.

Hamburg is also one of Germany's leading railroad centers. There is heavy rail traffic between the city and every part of Europe. National publications are published in Hamburg. They include the news magazine *Der Spiegel* and the newspapers *Die Zeit* and *Die Welt*.

In the 1200's, Hamburg was a leading member of the Hanseatic League, a confederation of North German cities. In the late 1800's and early 1900's, it was a state in the German Empire and the Weimar Republic.



Dan Porges, Bruce Coleman Inc.

Hamburg is located on the Elbe River in northwestern Germany. Over half of Hamburg's buildings were destroyed during World War II (1939-1945). But the city has been extensively rebuilt. Hamburg is now a center of modern architecture.

Hamburg State is a *land* (state) in Germany and is represented in the national parliament. Hamburg State has its own constitution, passed in 1952. It has a *Bürgerschaft* (parliament). The people elect the 120 Bürgerschaft members to four-year terms. Bürgerschaft members choose a 15-member senate to administer the laws. The *first bürgermeister* (chief official) heads the senate. Hamburg is divided into seven administrative districts.

Peter H. Merkl

Hamer, *HAYM uhr,* **Fannie Lou** (1917-1977), was a leading black American civil rights activist. Hamer was born in Montgomery County, Mississippi. The youngest of 20 children, she toiled as a sharecropper most of her life. Hamer began working for voting rights for blacks after she tried to register to vote in 1962 but was turned away. She succeeded in registering in 1963. Later that year, she was arrested for entering a "whites-only" restaurant. While Hamer was in jail, guards forced two prisoners to beat her.

In 1964, Hamer helped establish the Mississippi Freedom Democratic Party (MFDP) as a racially integrated alternative to the all-white Democratic Party of Mississippi. The MFDP tried but failed to get its slate of delegates seated at the 1964 Democratic National Convention. As part of this attempt, Hamer testified before a convention committee, telling of her experiences as a black person and as a civil rights activist. Hamer's testimony—which was nationally televised—did much to publicize the mistreatment of blacks and civil rights workers in the United States. Alton Hornsby, Jr.

Hamilcar Barca, *huh MIHL kahr* or *HAM uhl kahr* (? -229 B.C.), was a great general of Carthage and the father of Hannibal, Carthage's most famous general. In 247 B.C., during the First Punic War, Hamilcar took command of the Carthaginian forces in western Sicily. His forces fought the Romans valiantly, but the Carthaginians suffered a disastrous naval defeat. Carthage was forced to sue for peace in 241 B.C. After the war, Hamilcar put down a rebellion in Africa of *mercenaries* (hired troops) who had not been paid. He moved against other rebellious mercenaries on the island of Sardinia, but Rome stepped in and demanded and got Sardinia and money from Carthage.

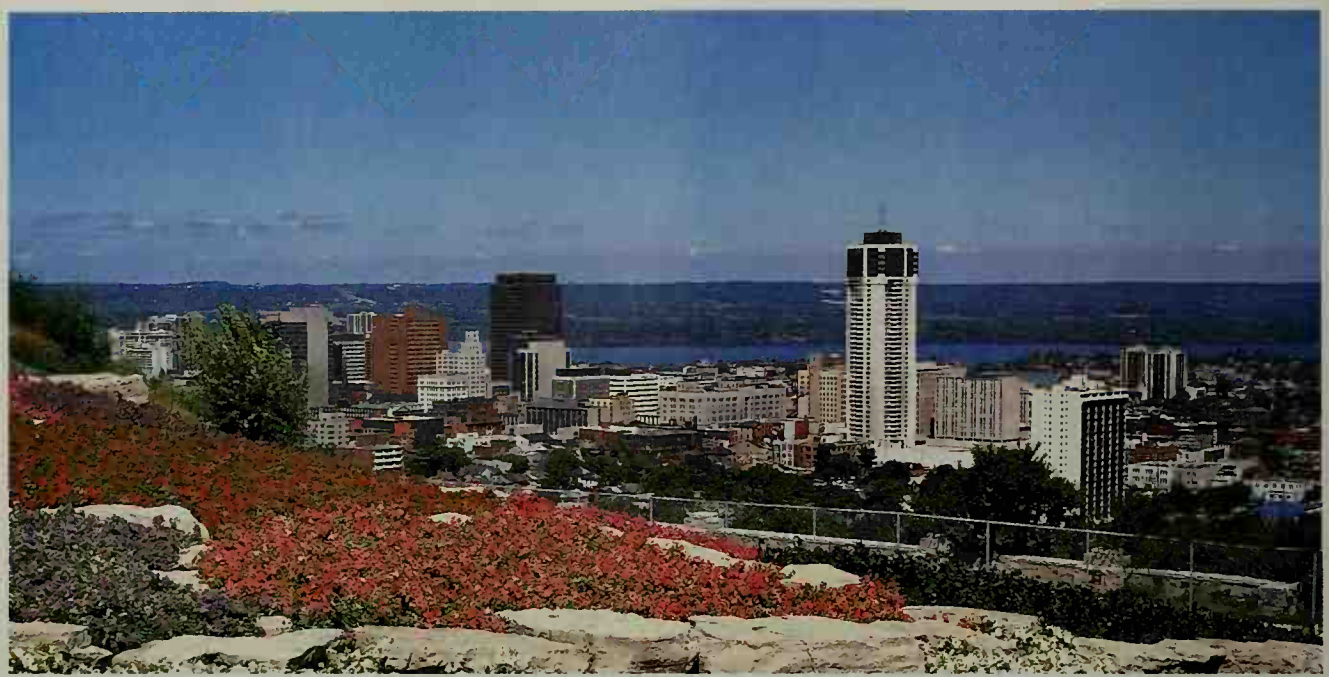
Hamilcar governed Carthage's holdings in Spain from about 237 B.C. until his death. He expanded Carthaginian power and territory. His work helped bring the economic strength that Carthage and Hannibal needed to fight the Second Punic War. Henry C. Boren

See also **Carthage; Hannibal; Barcelona.**

Hamilton (pop. 1,669) is the capital and chief port of Bermuda. It lies along the central coast of Bermuda Island. For location, see **Bermuda** (map).

Hamilton has many buildings that are painted in pastel colors. Few buildings are over three stories high.

Bermuda is a popular resort, and tourism is a major source of Hamilton's income. Cruise ships dock in the city's harbor along Front Street, the main street. Many shops are located along Front Street. Other attractions include Albouy's Point, site of the Royal Bermuda Yacht Club; a park called Par-La-Ville Gardens; and the Bermuda Historical Society, which displays items from Bermuda's past. Hamilton was founded in 1790. In 1815, it replaced St. George as the capital. Gustavo A. Antonini



Greater Hamilton Tourism and Convention Services

Downtown Hamilton, Ontario, includes many modern buildings. The city lies on Hamilton Harbour, on the west end of Lake Ontario. Hamilton is one of Canada's leading manufacturing centers.

Hamilton, Ontario, is the center of the Canadian steel industry. Plants in the Hamilton area produce about half the nation's steel. Hamilton's location on Hamilton Harbour on the west end of Lake Ontario makes the city an important link in the St. Lawrence Seaway route. Among Canada's inland ports, only Montreal and Thunder Bay handle more trade than Hamilton. Hamilton ranks as one of Ontario's largest cities in population.

George Hamilton, a pioneer farmer, laid out a town on the site in 1813. The town's position in the center of Ontario's most populated area helped it grow as a manufacturing and marketing center. Today, Hamilton ranks behind only Toronto and Montreal among Canadian manufacturing cities. But Hamilton's nearness to Toronto, which lies less than 50 miles (80 kilometers) away, has limited the city's growth. Many business companies have their headquarters in Toronto, with only smaller offices in Hamilton.

The city covers 431 square miles (1,117 square kilometers). It includes the urban and rural areas that, until 2001, were part of the region of Hamilton-Wentworth and the municipalities of Ancaster, Dundas, Flamborough, Glanbrook, and Stoney Creek. Other communities in the Hamilton area include Grimsby and Burlington.

Most of Hamilton lies on a plain between Hamilton Harbour and the Niagara Escarpment, a high ridge that the people of the area call "the Mountain." Hamilton Harbour is a landlocked triangular harbor. A long sand bar called Burlington Beach separates the harbor from Lake Ontario. Ships traveling from the lake enter the harbor through a short canal. Motor vehicles cross the canal via the James N. Allan Burlington Bay Skyway.

The intersection of James and King streets is the center of the Hamilton business district. City Hall stands a few blocks away at Main and Bay streets. The Canadian Football Hall of Fame and Museum is next to City Hall. A modern shopping mall and several office buildings occupy Lloyd D. Jackson Square across the street from City Hall. Nearby is Hamilton Place, a theater-auditorium complex. The Art Gallery of Hamilton and the Hamilton Trade and Convention Centre adjoin Hamilton Place. Two blocks away is the Copps Coliseum, which seats 18,000 people.

Hamilton's steel mills and factories stand along the waterfront. The Royal Botanical Gardens, including Cootes Paradise Marsh, occupy about 2,000 acres (810 hectares) at the west end of the harbor.

People. About three-fourths of the people in the Hamilton area were born in Canada. About half of the people have some English ancestry. People of Scottish and Irish descent make up the next largest groups. The Hamilton area also has many people of French, Italian, and German ancestry.

Economy. Steelmakers in the Hamilton area produce about 8 $\frac{1}{4}$ million tons (7.5 million metric tons) of steel each year. Ships bring iron ore to the area's steel plants from northern Quebec via the St. Lawrence Seaway.

Industry employs about 65 percent of the workers of metropolitan Hamilton. More than 750 Hamilton factories produce a total of over $2 billion worth of goods annually. The city makes many steel products, including

Facts in brief

Population: 490,268. *Metropolitan area population*—662,401.
Area: 431 mi² (1,117 km²). *Metropolitan area*—530 mi² (1,372 km²).
Climate: *Average temperature*—January, 23 °F (−5 °C); July, 71°F (22 °C). *Average annual precipitation* (rainfall, melted snow, and other forms of moisture)—32 in (81 cm).
Government: Mayor-council. *Terms*—3 years for the mayor and 15 councilors.
Founded: 1813. Incorporated as a city in 1846.

automotive parts, electrical goods, farm and machine tools, and wire.

Hamilton plants also process beef, dairy products, fruits, tobacco, and vegetables from the rich farming region south of the city. Farmers sell fresh produce at Hamilton's Central Market.

Three Canadian railroads run through Hamilton and connect with several major U.S. lines. Seven major highways serve the city, and two bus lines provide both local and long-distance service. Hamilton's Civic Airport furnishes service to a number of Canadian and U.S. cities. Lester B. Pearson International Airport, just outside Toronto, lies an hour's drive from Hamilton. Hamilton's port handles about 14 million tons (13 million metric tons) of cargo annually.

Hamilton has one daily newspaper, *The Hamilton Spectator*. The city is served by eight radio stations and several television stations.

Education. About 60,000 children attend about 120 public elementary schools and approximately 20 public high schools in Hamilton. The city has about 60 Roman Catholic schools, which are attended by about 30,000 students.

McMaster University has about 15,000 students. It owns the only nuclear reactor on a Canadian university campus. In 1971, McMaster opened its Health Sciences Centre, a combination hospital and medical school. Hamilton is also the home of Mohawk College of Applied Arts and Technology.

Two public library systems, the Hamilton Public Library and the Wentworth Library, serve the city and the surrounding region. The Hamilton Public Library has a central library and 25 branches. Its collection consists of more than 1 $\frac{1}{2}$ million items, including books, magazines, compact discs, and videos.

Cultural life. Opera Hamilton, the Bach Elgar Choir, and the New Hamilton Orchestra perform in Hamilton Place. The Art Gallery of Hamilton features drawings, paintings, prints, and sculptures from Canada, France, the United Kingdom, and the United States. Dundurn Castle, in Dundurn Park, includes a museum with exhibits of coins, costumes, and furniture from the middle 1800's. Sir Allan MacNab, a Canadian statesman, built the mansion and modeled it after a Scottish castle. The Cockpit Theatre and a children's theater are also in the park.

Hamilton has about 300 parks. The Royal Botanical Gardens also lie partially in Hamilton. Parts of the gardens, including the Rock Garden, have been formally developed. But other sections remain in their natural state. The gardens offer educational programs and tours.

Hamilton has numerous recreational facilities. These facilities include playgrounds, recreation centers, golf courses, ice-skating rinks, and tennis courts. In addition, the city is the home of the Hamilton Tiger-Cats of the Canadian Football League.

Government. Hamilton has a mayor-council form of government. The voters elect a mayor and 15 councilors to three-year terms. The city gets most of its revenue from local property taxes and from provincial and federal grants.

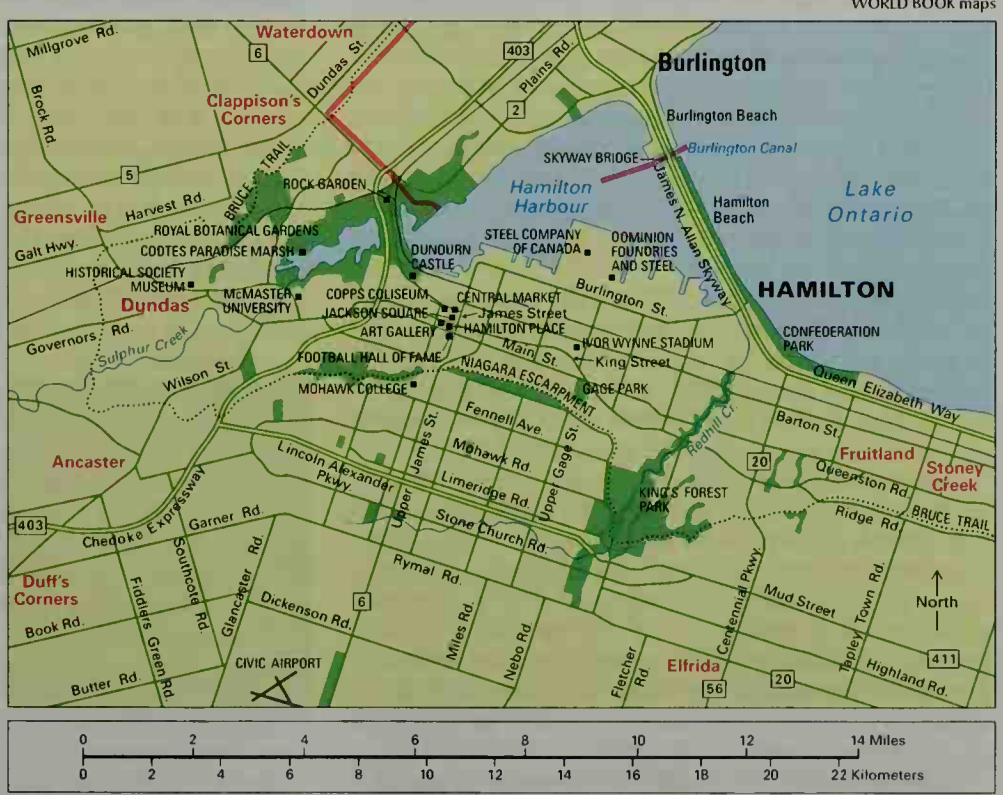
History. Huron Indians lived in what is now the Hamilton area before whites settled there. French fur traders and explorers charted the region during the 1660's, but no whites settled in the area until 1778. That year, two American colonists who supported the British moved there to escape the Revolutionary War in America (1775-1783).

In 1813, George Hamilton, a member of a leading Ca-

City of Hamilton

Hamilton, on the shore of Lake Ontario, is the center of Canada's steel industry. The map shows points of interest in the Hamilton area.

WORLD BOOK maps



nadian family, bought the land at the head of Lake Ontario and had it surveyed for a town. The town grew slowly until 1832, when the completion of a ship channel increased trade. Hamilton had 6,832 people when it was incorporated in 1846.

During the construction of the Great Western Railroad, from 1849 through 1855, Hamilton's population increased from 7,000 to 28,000. This railroad, promoted by Sir Allan MacNab, ran from the Niagara River via Hamilton, along Lake Erie to Windsor and Sarnia, Ontario. Hamilton's first foundry was established during this period to meet the railroad's need for steel. By 1910, Hamilton mills had joined with others in Ontario and Montreal to form the Steel Company of Canada, Limited (Stelco Inc.), Canada's largest steel producer. The city's population grew from 52,000 in 1901 to 82,000 in 1911. Hamilton's second steel firm, Dominion Foundries and Steel, Limited (Dofasco Inc.), started operations in 1912. By 1921, the population had passed 100,000, and by 1951 it had gone over 200,000.

During the 1960's, Hamilton began major air and water improvement programs, including construction of a water purification system. City leaders hoped to give Hamilton a new look with the construction of residential and commercial developments in the 1960's and early 1970's. But developers had difficulties finding tenants for high-rise apartment and office buildings. Businesses preferred to have their main offices in Toronto, and many families preferred houses over apartments.

Hamilton entered the 1970's with a metropolitan population of almost 500,000. The city's chief renewal plans for the downtown area centered on Lloyd D. Jackson Square. The first buildings constructed on the square included a 24-story office tower and a banking pavilion. Fifty new stores and an office building opened in the complex in 1977. Another office tower, with 200 additional ground-level stores, was completed in 1984. A hotel opened in 1985. The buildings in Jackson Square are connected to the Convention Centre and Hamilton Place Theatre by enclosed aboveground walkways.

In 1999, the Ontario legislature passed a law to enlarge Hamilton. The new city boundaries went into effect at the beginning of 2001. The city now includes the urban and rural areas that had been part of the region of Hamilton-Wentworth and the municipalities of Ancaster, Dundas, Flamborough, Glanbrook, Hamilton, and Stoney Creek. Gerry Nott

Hamilton, Alexander (1755 or 1757-1804), was a noted statesman and political leader during the early years of the United States. He served in President George Washington's Cabinet as the nation's first secretary of the treasury. He also was a leader of the Federalist Party, one of the first political parties in the nation.

Hamilton was one of the boldest and most creative thinkers of his time. He supported the establishment of a strong federal government and believed that the U.S. Constitution should be interpreted loosely to give the government greater powers. Hamilton also favored the development of manufacturing to achieve an economic balance between agriculture and industry. He worked to protect the interests of merchants and other business leaders and believed the nation could best be governed by people from these groups.

Many of Hamilton's policies were strongly opposed by Thomas Jefferson and other political leaders of the time. But today, scholars agree that Hamilton's ideas have had lasting importance.

Portrait by John Trumbull, Metropolitan Museum of Art

Alexander Hamilton

Early life. Hamilton claimed he was born on Jan. 11, 1757, but scholars have found evidence that shows the year of his birth to have been 1755. Hamilton was born on the island of Nevis in the West Indies. He was the second child of James Hamilton, a Scottish merchant, and Mrs. Rachael Lavien, who was separated from her husband. In 1765, James Hamilton left her and their two children.

As a boy, Alexander Hamilton worked for a trading firm on St. Croix, an island in what is now the Virgin Islands of the United States. His talents so impressed his employers that they helped send him to school in North America in 1772. He attended a school in Elizabethtown (now Elizabeth), New Jersey, and then entered King's College (now Columbia University).

In 1776, during the Revolutionary War, Hamilton was appointed captain of a New York artillery company. From 1777 to 1781, he served as a secretary and close assistant of General George Washington.

In 1780, Hamilton married Elizabeth Schuyler, the daughter of a wealthy New York family. Hamilton and his wife had eight children.

Early political career. Hamilton was admitted to the bar in New York in 1782 and soon began to practice law there. Also in 1782, he became a delegate from New York to the Congress of the Confederation. The Congress had been established by the Articles of Confederation in 1781, but it had little power (see **Articles of Confederation**). In 1786, Hamilton wrote a proposal calling for a convention of the states for the purpose of strengthening the federal government.

The Constitutional Convention met in Philadelphia in 1787. Few of Hamilton's ideas were included in the U.S. Constitution, but he worked hard for its ratification by the states. Hamilton and two other statesmen, John Jay and James Madison, wrote letters to newspapers urging approval of the Constitution. These letters were later republished in an influential book called *The Federalist* (see **Federalist, The**).

Secretary of the treasury. Hamilton became secretary of the treasury in 1789. He proposed that Congress establish a national bank to handle the government's financial operations. This measure was opposed by Secretary of State Thomas Jefferson, who did not believe that Congress had the power to establish such an institution. Hamilton then developed the *doctrine of implied powers*. This doctrine states that the government has *implied powers* (those reasonably suggested by the Constitution). The Supreme Court later upheld this doctrine.

Hamilton wanted the government to encourage manufacturing, and he recommended measures for that purpose. Jefferson and Madison opposed such a program because they thought that it would hurt farming inter-

ests. Congress partly followed Hamilton's suggestions.

In the early 1790's, the conflicts between Hamilton and a group led by Jefferson and Madison resulted in the development of the nation's first two political parties. Hamilton led the Federalist Party, which favored a strong federal government. The Democratic-Republican Party, headed by Jefferson and Madison, wanted a weak national government.

Political disputes. In 1795, Hamilton resigned as treasury secretary because of personal financial problems and increased opposition in Congress. But he remained active in public life and in 1796 helped President Washington write his Farewell Address.

John Adams, a Federalist, became president in 1797. Adams and Hamilton had many personal disputes, and they also disagreed about foreign policy and other issues. Shortly before the election of 1800, Hamilton wrote a pamphlet attacking the president. The pamphlet widened a split among the Federalists. As a result, the Democratic-Republican candidates, Thomas Jefferson and Aaron Burr, won the election. Jefferson and Burr received an equal number of electoral votes. Under the voting procedure in use at the time, both men were eligible for the presidency. The House of Representatives had to decide the winner. Hamilton, who distrusted Burr more than he distrusted Jefferson, supported Jefferson for president. Jefferson won, and Burr became vice president. See **Jefferson, Thomas** (National statesman).

Burr ran for governor of New York in 1804. Hamilton criticized Burr's character and worked to defeat him. Burr lost and then challenged Hamilton to a duel with pistols. The two men fought on July 11, 1804. Hamilton was shot and died the next day. Jacob E. Cooke

See also **Burr, Aaron.**

Additional resources

Brookhiser, Richard. *Alexander Hamilton, American.* Free Pr., 1999.

Walling, Karl-Friedrich. *Republican Empire: Alexander Hamilton on War and Free Government.* Univ. Pr. of Kans., 1999.

Hamilton, Alice (1869-1970), was an American doctor who pioneered in industrial medicine. Her efforts led to greatly improved health conditions in industrial workplaces and to the introduction of workers' compensation laws in the United States (see **Workers' compensation**). From 1911 to 1920, she was a special investigator for the U.S. Department of Labor. She inspected mines, mills, and smelting plants throughout the country and reported on the poisoning of factory workers by lead and other harmful substances. In many cases, she personally persuaded business owners to correct unsafe working conditions.

Jane Addams Memorial Collection, University of Illinois, Chicago

Alice Hamilton

Hamilton was born on Feb. 27, 1869, in New York City. She grew up in Fort Wayne, Indiana. She graduated from the medical department of the University of Michigan in 1893. From 1897 to 1919, Hamilton lived and worked at Hull House, the famous Chicago settlement house founded by her friend Jane Addams (see **Hull House**). In 1919, Hamilton became the first woman faculty member of Harvard University. Miriam Schneir

Hamilton, Virginia (1936-2002), was an American author of children's books. She wrote imaginatively about the heritage of African Americans in her novels, folk tales, and nonfiction. Hamilton won the 1975 Newbery Medal and the 1975 National Book Award for her novel *M.C. Higgins, the Great* (1974), a story about a poor black boy growing up in the rural South. She became the first black person to be awarded the Newbery Medal. Hamilton received the Regina Medal in 1990 and the Laura Ingalls Wilder Award in 1995.

Hamilton's other children's novels include *Zeely* (1967), *The House of Dies Drear* (1968), *The Planet of Junior Brown* (1971), *Arilla Sun Down* (1976), *Junius Over Far* (1985), *The Bells of Christmas* (1989), *Cousins* (1990), and *Plain City* (1993). She also wrote *The People Could Fly: American Black Folktales* (1985), *Her Stories: African American Folk Tales, Fairy Tales and True Tales* (1995); and biographies of African American leaders Paul Robeson and W. E. B. Du Bois. Hamilton was born in Yellow Springs, Ohio, on March 12, 1936. Virginia L. Wolf

Hamilton, William Donald (1936-2000), was a British biologist famous for his work on the theory of evolution. Hamilton advanced evolutionary theory using *genetics* (the study of heredity) and animal behavior studies. His major contribution has become known as the idea of *inclusive fitness* or *kin selection.* According to this idea, individual organisms can ensure the survival of their own *genes* (hereditary material) by behaving selflessly toward close relatives other than their offspring. For example, worker ants in an ant colony do not breed, but they help raise the offspring of the colony's queen ant, to which they are all closely related. Such closely related animals have many of the same *genes* (hereditary material). Thus, Hamilton concluded, selfless behavior toward relatives helps ensure that the worker ants pass on their own genes from one generation to another.

Hamilton was born on Aug. 1, 1936, in Cairo, Egypt. He graduated from Cambridge University in 1960 and earned a Ph.D. degree in genetics from the University of London in 1968. Hamilton taught genetics and evolutionary biology at the University of London, the University of Michigan, and Oxford University. His most important scientific writings include "The Genetical Evolution of Social Behavior" (1964), "Extraordinary Sex Ratios" (1967), and "Altruism and Related Phenomena Mainly in Social Insects" (1972). Hamilton died in Oxford on March 7, 2000. Keith R. Benson

See also **Ethology; Sociobiology.**

Hamilton-Gordon, John Campbell. See **Aberdeen and Temair, Marquess of.**

Hamites are certain African peoples who live mainly in eastern, northern, and northeastern Africa, including parts of Eritrea, Ethiopia, the Sahara, and the Sudan. Most Hamites are tall and have a narrow nose and brown skin. They are sometimes called *Afro-Mediterranean* peoples because of their physical characteristics and the region where they live. Because much of this region cannot be farmed, most Hamites tend herds of camels, cattle, goats, and sheep.

The ancient Egyptians were Hamites. Present-day Hamitic peoples include the Beja, Berbers, Fulani, Oro-

mo, and Somali. The languages of Hamites have been called *Hamitic,* but this term correctly refers only to race. The languages belong to the Cushitic group of Afro-Asiatic languages. Wade C. Pendleton

See also **Berbers; Fulani; Somalia.**

Hamlin, Hannibal (1809-1891), was vice president of the United States from 1861 to 1865, during President Abraham Lincoln's first term. Hamlin was a strong opponent of slavery.

From 1843 to 1847, Hamlin, then a Democrat, represented Maine in the U.S. House of Representatives. He represented the state as a U.S. senator from 1848 to 1857. In 1856, Hamlin joined the antislavery Republican Party. He was governor of Maine for a few weeks in 1857. But he returned to the Senate that year, serving from 1857 to 1861 and 1869 to 1881.

Lincoln dropped Hamlin as his running mate in 1864 and chose Andrew Johnson, a Union Democrat from Tennessee, to balance the Republican ticket. Hamlin was ambassador to Spain in 1881 and 1882.

Hamlin was born in Paris, Maine, on Aug. 27, 1809. His statue represents Maine in Statuary Hall in Washington, D.C. Michael Perman

See also **Vice president of the United States** (picture).

Hammarskjöld, *HAH muhr SHOHLD,* **Dag,** *dahg* (1905-1961), was secretary-general of the United Nations from 1953 until his death in a plane crash in Africa. After his death, Hammarskjöld was awarded the 1961 Nobel Peace Prize for his efforts to bring peace to the Congo.

Hammarskjöld worked to ease tension between the United States and the Soviet Union. In 1955, he secured the release from China of American prisoners captured during the Korean War. In 1956, he helped solve the Suez crisis between Egypt and Israel and Israel's allies, the United Kingdom, and France.

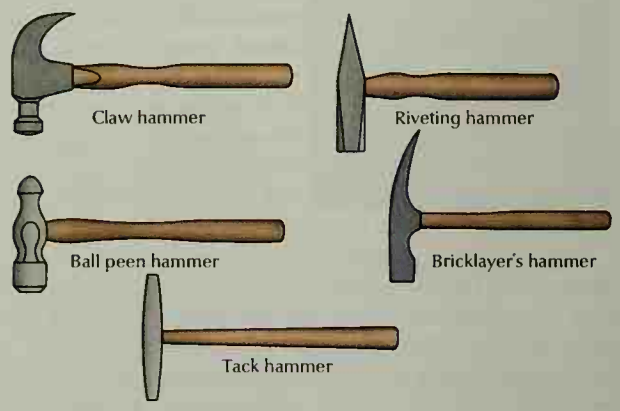
Hammarskjöld was born on July 29, 1905, in Jönköping, Sweden. His father was once Sweden's prime minister. In 1941, Hammarskjöld became the youngest chairman of the Bank of Sweden in the bank's history. Hammarskjöld was deputy foreign minister of Sweden from 1951 to 1953. *Markings,* a book of poetry, prayers, and prose sayings written by Hammarskjöld, was published in 1964. Raymond E. Lindgren

See also **United Nations** (The secretary-general; picture).

Hammer is a tool used to drive nails and to work metals and other materials. Carpenters use a *claw hammer,* which has a *face* (striking surface) at one end, and a *claw* for pulling nails at the other end. Other types of hammers include the *stone hammer,* the *mason's hammer,* the *tack hammer,* and the *machinist's hammer,* which is also called the *ball peen hammer.* Alva H. Jared

Types of hammers

Hammers are made in many different shapes and sizes to do a variety of jobs. A comfortable grip on the handle and good balance are important factors in choosing a hammer.



Hammer throw is a men's track and field event in which an athlete throws a *hammer* (metal ball) as far as he can. The hammer weighs 7.26 kilograms (16 pounds). The thrower holds it with a metal grip that is connected to the ball by a steel wire. The entire hammer measures from 117.5 to 121.5 centimeters (46 $\frac{1}{4}$ to 47 $\frac{3}{4}$ inches) long. The athlete throws the hammer from a circle 2.13 meters (7 feet) in diameter.

At the beginning of his throw, the athlete faces the back of the circle and places his feet wide apart. He grips the metal handle with both hands, then swings the hammer around his head. When the hammer has gained enough momentum, the thrower takes three or four spins across the circle. A right-handed thrower spins on his left foot to increase the hammer's speed. At the end of the last spin, he has developed great momentum in the whirling hammer, which he then releases. The throw is measured from the edge of the circle to the nearest mark made by the hammer. Michael Takaha

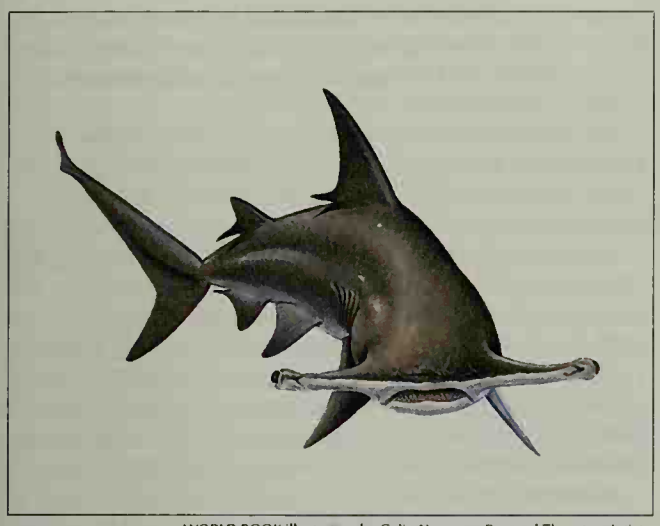
See also **Track and field** (table: World track and field records); **Olympic Games** (table: Track and field).

Hammerhead shark is any of nine species of meat-eating sharks that have a wide, flattened head. In most species, the head resembles a hammer. One eye and one nostril are located at each end of the head.

Hammerhead sharks live in tropical and warm temperate seas worldwide. They are found in coastal waters and in the open ocean. Some species live alone, but oth-

Larry Day

The hammer throw requires strength and skill. The thrower whirls around in a circle, swinging the hammer in a lopsided plane. When he gains sufficient momentum, he lets the hammer fly.



WORLD BOOK illustration by Colin Newman, Bernard Thornton Artists

A hammerhead shark has a wide, flattened head.

ers may form schools of hundreds of individuals. Hammerhead sharks range in size from the *bonnethead,* which is about 5 feet (1.5 meters) long, to the *great hammerhead,* which may reach about 20 feet (6.1 meters).

Scientists think the flat head improves the animal's ability to swim and provides extra space for sensing organs that help the shark find food. The wide separation of the nostrils may help the shark "home in" on an odor trail when searching for food. The widely spaced eyes may aid in scanning surroundings.

Hammerheads eat a variety of fish and shellfish. On rare occasions, the great hammerhead has attacked human beings. Hammerheads are caught for food worldwide, and their numbers have declined in some seas, such as off Mexico and Costa Rica.

Scientific classification. Hammerhead sharks belong to the family Sphyrnidae. The bonnethead is *Sphyrna tiburo.* The great hammerhead is *S. mokarran.* John E. McCosker

See also **Shark.**

Hammerstein, Oscar, II (1895-1960), wrote the lyrics and scripts for many of the most famous shows in the history of American musical theater. He worked with such great composers of musical comedies as Jerome Kern and Richard Rodgers. Hammerstein maintained an optimistic attitude that was reflected in his songs. These included "Oh, What a Beautiful Mornin' "; "You'll Never Walk Alone"; and "My Favorite Things."

Hammerstein helped revolutionize musical comedies. When he began his career, most musicals consisted of a series of unrelated songs and dances that were held together by a weak plot. Hammerstein integrated the dialogue, songs, and dances into a unified work.

Culver Pictures

Oscar Hammerstein

Oscar Greeley Clendenning Hammerstein was born in New York City and graduated from Columbia University. He wrote his first musical, *Always You* (1920), with the composer Herbert Stothart. He worked with Stothart and Rudolph Friml on *Rose-Marie* (1924). His other early musicals include *The Desert Song* (1926) and *The New Moon* (1928), written with Sigmund Romberg. Hammerstein wrote his first masterpiece, *Show Boat* (1927), with Kern. This show was Hammerstein's first musical in which the songs and dances helped tell the story.

Hammerstein and Rodgers teamed up for the first time in *Oklahoma!* (1943), which won a Pulitzer Prize in 1944. They wrote eight other musicals—*Carousel* (1945), *Allegro* (1947), *South Pacific* (1949), *The King and I* (1951), *Me and Juliet* (1953), *Pipe Dream* (1955), *Flower Drum Song* (1958), and *The Sound of Music* (1959). In 1950, the two men shared a Pulitzer Prize for *South Pacific* with Joshua Logan, who helped write the dialogue for that musical. Paul F. Wells

See also **Kern, Jerome; Rodgers, Richard.**

Hammett, Dashiell, *HAM iht, DASH eel* (1894-1961), was the leader of the "hard-boiled" school of detective fiction. His stories feature "tough guys," realism, brutality, and violence. Many of his novels center around a *private eye* (private investigator). In *Red Harvest* (1929) and *The Dain Curse* (1929), Hammett introduced the "Op" (operative), an agent for the Continental Detective Agency. Sam Spade appears in *The Maltese Falcon* (1930) and Ned Beaumont in *The Glass Key* (1931). Hammett created the witty amateur detectives Nick and Nora Charles in *The Thin Man* (1934). Several of Hammett's short stories were collected in *The Big Knockover* (1966) and *The Continental Op* (1974).

Samuel Dashiell Hammett was born in St. Mary's County, Maryland. Many of his stories reflect his personal experiences as a private detective for the Pinkerton Agency. In 1922, Hammett began writing for *Black Mask,* a magazine that specialized in publishing "hard-boiled" detective stories. David Geherin

Hammond, John Hays, Jr. (1888-1965), was an American inventor. He obtained hundreds of patents for his developments in radar, radio, television, and other electronic devices.

Hammond pioneered in the development of remote control. His devices for the remote control of ships, airplanes, and torpedoes aided the U. S. Army and Navy during World Wars I and II. Hammond also invented electronic circuits that stabilized and guided remote control vehicles. These circuits played an important role in the development of rocketry. Hammond also improved tuning systems for frequency modulation (FM) radio. Hammond was born in San Francisco. He graduated from Yale University in 1910. Michael M. Sokal

Hammurabi, *HAH mu RAH bee* (? -1750 B.C.), also spelled *Hammurapi,* was a king of Babylonia who expanded his kingdom into the first great Babylonian empire. He also assembled one of the earliest written collections of laws, the Code of Hammurabi.

Hammurabi ruled Babylonia from 1792 to 1750 B.C. When he came to the throne, his kingdom consisted of the city of Babylon (near present-day Al Hillah, Iraq) and some surrounding territory. Babylonia was a small kingdom in Mesopotamia, a region that covered most of modern Iraq and parts of Syria and Turkey. Hammurabi conquered all the other kingdoms south to the Persian Gulf and united them under the Old Babylonian Empire. But most of the kingdoms regained their independence after his death.

The Louvre, Paris (Raymond V. Schoder, S. J.)

Hammurabi, king of Babylonia, stands before the god Shamash, patron of justice. This relief is at the top of the text of the Code of Hammurabi. It shows Shamash commanding the king to establish just laws. The monument with code and relief, known as the stele of Hammurabi, was found in the ruins of Susa in Iran.

Hammurabi based his code of laws on older collections of Sumerian and Akkadian laws, which he revised and expanded. One principle of the Code of Hammurabi is that "the strong shall not oppress the weak." The code begins with a *prologue* (introduction) celebrating Hammurabi's military victories. He promises to treat conquered peoples justly and says he honors their gods. The provisions of the code cover many legal matters, including false accusation, witchcraft, military service, land and business regulations, family laws, tariffs, wages, trades, loans, and debts.

In 1901 and 1902 in southwestern Iran, Vincent Scheil, a French archaeologist, unearthed several of the stone monuments on which the code was carved. The monuments lay in the ruins of Susa, capital of the ancient kingdom of Elam. An Elamite king had taken them there as a war trophy.

Much of what scholars know about Old Babylonian society and how it was divided into social classes comes from the Code of Hammurabi. The code also provides a valuable example of Akkadian, the ancient Babylonian language in which it is written. Norman Yoffee

Hampton, Virginia (pop. 146,437), lies on a peninsula at the south end of Chesapeake Bay, across from Norfolk (see **Virginia** [political map]). Hampton is the home of Langley Air Force Base and a major research facility of the National Aeronautics and Space Administration. The defense and aerospace industries are the city's largest employers. Hampton is also an important fishing port. Hampton University was founded there in 1868 as Hampton Institute. Settled in 1610, Hampton is the oldest town founded by the English still in existence in the United States. It has a council-manager government.

Susan L. Woodward

See also **Hampton Roads; Hampton University.**

Hampton, Lionel (1909-), is an American jazz musician. He established the vibraphone as an accepted jazz instrument.

Hampton was born in Louisville, Kentucky. During the 1920's, he lived in California, where he performed as a drummer. Hampton began his vibraphone career in 1930. From 1936 to 1940, he recorded regularly with clarinetist Benny Goodman and appeared on most of Goodman's famous combo recordings. From 1937 to 1941, Hampton organized and played on 23 small group recording sessions that rank among the finest in jazz.

Hampton formed his own band in 1940 and has led various big bands and small groups since that time. His first big band made a hit recording of "Flying Home" in 1942, which has become Hampton's unofficial theme song. Hampton's bands and small groups usually consist of young musicians with a core of experienced players. Hampton's exuberant personality and showmanship have contributed to his popularity with audiences. *Hamp* (1989) is his autobiography. Eddie Cook

See also **Jazz** (picture: Benny Goodman).

Hampton, Wade (1818-1902), was a Confederate general in the American Civil War (1861-1865). In 1864, he became commander of all of General Robert E. Lee's cavalry. Later, in South Carolina, Hampton tried to prevent Union General William T. Sherman's march northward from Savannah, Georgia.

Hampton was born in Charleston, South Carolina. He was the grandson of General Wade Hampton, who fought in both the Revolutionary War (1775-1783) and the War of 1812. After the Civil War, he entered politics. He was elected governor of South Carolina in 1876 and 1878 and served as a U.S. senator from 1878 to 1891. South Carolina placed a statue of Hampton in the U.S. Capitol in Washington, D.C., in 1929. John F. Marszalek

Hampton Court Conference was a meeting called in 1604 by King James I of England. Its purpose was to settle disputes between bishops and religious reformers called Puritans over matters of ceremony and discipline in the Church of England. The conference, held at Hampton Court Palace, now in London, lasted three days and led to minor changes in the Book of Common Prayer. But it failed to bring about major reforms desired by the Puritans. An important legacy of the conference was its call for an official translation of the Bible to be used in all churches. This action resulted in the King James, or Authorized, Version of the Bible, which appeared in 1611. See also **Puritans.** Dale A. Johnson

Hampton Roads is a natural channel and harbor formed at the place where the Nansemond, James, and Elizabeth rivers meet in Virginia. These rivers flow through Hampton Roads into Chesapeake Bay. The channel lies between Old Point Comfort and Sewall's Point. Newport News and Hampton lie on the north shore of the channel, and Norfolk and Portsmouth on the south shore. The famous Civil War battle between the *Monitor* and the *Merrimack* occurred at Hampton Roads. The Hampton Roads Conference, an attempt to end the war, was held in 1865. Michael P. O'Neill

Hampton Roads, Battle of. See Monitor and Merrimack; Civil War (First battle between ironclads).

Hampton Roads Conference was an attempt to end the American Civil War (1861-1865). On Feb. 3, 1865, representatives of the North and South met on the *River Queen,* a ship in Chesapeake Bay. The ship was anchored at Hampton Roads, near Fort Monroe (also called Fortress Monroe). President Abraham Lincoln and Secretary of State William Henry Seward represented the North. The South was represented by the Confederacy's vice president, Alexander H. Stephens, and by Confederate Senator Robert M. T. Hunter and Assistant Secretary of War John A. Campbell.

Both sides approached the meeting with widely differing views regarding acceptable peace terms. Lincoln refused to change any terms of the Emancipation Proclamation, or to consider any peace proposal that did not involve immediate restoration of the Union and the laying down of Confederate arms. The representatives failed to reach an agreement. James E. Sefton

Hampton University is a private coeducational university in Hampton, Virginia. It has played a historic role in the education of blacks and American Indians. It has schools of business, liberal arts and education, nursing, and pure and applied sciences. It also has a graduate college and a college of continuing education. The university grants bachelor's and master's degrees.

The school was founded in 1868 to help educate slaves freed after the American Civil War. In 1870, it was chartered as Hampton Normal and Agricultural Institute. From 1878 to 1912, the school received federal aid for the education of American Indians. It began a college curriculum in 1923 and, in 1930, the name was changed to Hampton Institute. The present name was adopted in 1984. Critically reviewed by Hampton University

Hamster is any of several kinds of small, chunky, furry rodents that live in Asia and Europe. Most kinds of hamsters have a short tail and large cheek pouches in which they can carry a great amount of food. There are about 15 kinds of hamsters. The best-known species are the *golden hamster* and the *common hamster.*

The golden hamster, also called the *Syrian hamster,* has light reddish-brown fur on its back and white fur on its underside. Golden hamsters measure about 7 inches (18 centimeters) long and have a tail $\frac{1}{2}$ inch (13 millimeters) long. The animals weigh about 4 ounces (112 grams).

The common hamster is also called the *black-bellied hamster* because it has black fur on its underside. It has light brown fur on its back and white spots on its face, neck, and sides. Common hamsters measure about 11 inches (28 centimeters) long and weigh up to 32 ounces (908 grams). They are trapped for their fur.

Golden and common hamsters live alone and are active mostly at night. They dig burrows that have separate compartments for nesting, food storage, and body wastes. Hamsters eat many different kinds of food, including fruits, seeds, green vegetation, and some small animals.

A female golden hamster carries her young in her body for 16 days, and the common hamster carries hers for 16 to 20 days. Both species generally give birth to six or seven young. Wild females usually have two litters a year, but they may give birth as often as once a month in captivity. Newborn hamsters are completely helpless and are cared for by the mother hamster for about three weeks.

Oxford Scientific Films from Animals Animals

A golden hamster is light reddish-brown with white underparts. Many people keep hamsters as pets.

Golden hamsters are frequently used as experimental animals in scientific research. They are also popular pets because they are easy to care for.

Pet hamsters should be kept in metal cages or in glass or plastic enclosures. Wood shavings, dried grass, or some other absorbent material should line the cage floor. Hamsters may be given many kinds of food, including fruits, greens, raw vegetables, small grains, and some meat. Fresh water should be available at all times. Pet hamsters live three to four years. Clark E. Adams

Scientific classification. Hamsters belong to the family Cricetidae. The scientific name for the golden hamster is *Mesocricetus auratus.* The common hamster is *Cricetus cricetus.*

Additional resources

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Hamsun, *HAHM sun,* **Knut,** *knoot* (1859-1952), was a Norwegian author who wrote with deep feeling about nature and the land. He won the 1920 Nobel Prize for literature for his novels. His best-known novel, *The Growth of the Soil* (1917), realistically describes the hard life of peasants in rural Norway. His early novels, *Hunger* (1890), *Mysteries* (1892), and *Pan* (1894), study those who have been rejected by society and who, in turn, reject society.

Hamsun was born in Lom, Norway. He spent most of his early adult life wandering from job to job. Eventually, Hamsun favored a strong central government that would control society. He supported the World War II German occupation of Norway, and was later arrested and fined for pro-German activities. However, his powerful novels transcend the limitations of his political views. Niels Ingwersen

Han dynasty, *hahn,* was a series of emperors of the same family who ruled ancient China for over 400 years. Under Han rule, arts and sciences thrived and China became as large and as powerful as the Roman Empire.

The Han Empire about A.D. 100

This map shows the Han Empire at its greatest size. A major expansion occurred about 100 B.C., when the empire was extended west into central Asia. Then, for the first time in history, overland trade routes linked China with Europe.

WORLD BOOK map

The Chinese still refer to themselves as Han people in recognition of China's great achievements in this period.

Liu Bang (also spelled Liu Pang) founded the Han dynasty in 202 B.C., after the fall of the Qin (Ch'in) dynasty (see **Liu Bang**). The Han rule was divided into two periods. The *Former* Han dynasty lasted from 202 B.C. to A.D. 8. Its capital was Chang'an (now Xi'an). The *Later* Han dynasty lasted from A.D. 25 to 220, and its capital was Luoyang. Because Chang'an lay west of Luoyang, the two periods are also called the *Western* and *Eastern* Han dynasties. From A.D. 8 to 23, China was ruled by Wang Mang, who set up the Xin (Hsin) dynasty. After the Xin fell, the Han soon regained control.

Han emperors after Liu had a strong centralized government. They used a civil service examination to select officials. This examination stressed knowledge of the teachings of Confucius. As a result, Confucian scholars held important government positions. Emperor Wudi, who ruled from 140 to 87 B.C., made Confucianism the state philosophy (see **Confucianism**).

Under Han rule, education grew in importance and a university was built in Chang'an. Poets and prose writers developed a clear style that is still famous in Chinese literature. Scholars wrote long histories of China. Artists produced glazed pottery and large stone carvings.

Han China expanded southwest to what is now Tibet. Han warriors also conquered what are now North Korea and northern Vietnam. Overland trade routes linked China with Europe for the first time. Along the most famous route, the Silk Road, Chinese silk and other products flowed into the Roman Empire.

The Han dynasty collapsed because of rivalries among powerful families, scholar-officials, imperial relatives, advisers, and generals. For the next 360 years, China was divided into warring states. Grant Hardy

See also China (The early empire).

Han Gaozu. See Liu Bang.

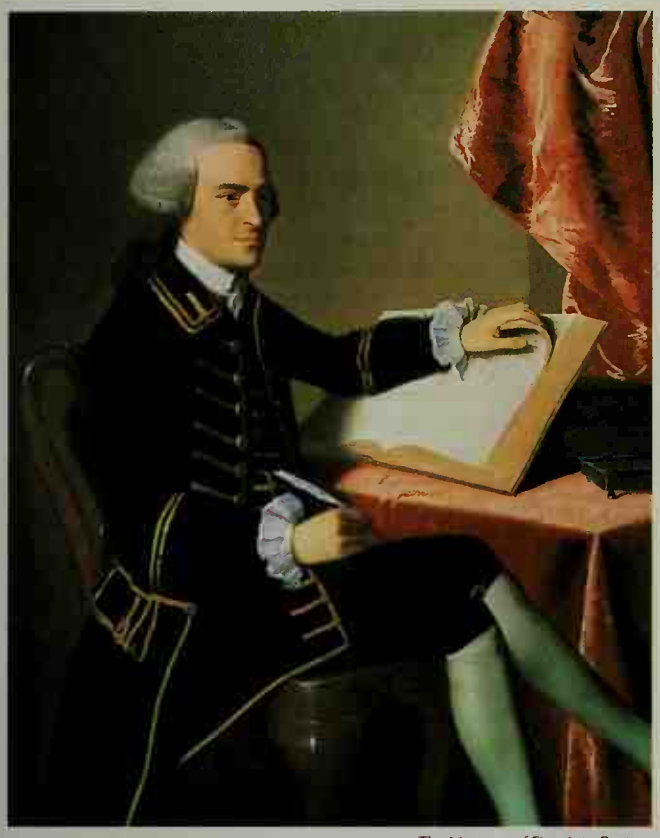
Hancock, Herbie (1940-), is a popular and influential jazz musician, bandleader, and composer. His 1973 recording *Head Hunters* became one of the best-selling albums in jazz history. The highly rhythmic album blends jazz and rock as performed by electronic piano and bass, synthesizers, keyboards, and percussion. The hit single," Chameleon," won audiences in rhythm and blues, pop music, rock, and jazz.

Herbert Jeffrey Hancock was born on April 12, 1940, in Chicago. He graduated from Grinnell College. Hancock won praise for his first album, *Takin' Off,* recorded in 1963. The album contained his hit composition "Watermelon Man." From 1963 to 1968, Hancock played piano in a famous quintet led by Miles Davis. During this time, Hancock wrote several major jazz compositions, including "Cantaloupe Island," "Dolphin Dance," "Maiden Voyage," "Riot," "The Sorcerer," and "Speak Like a Child."

After leaving Miles Davis, Hancock formed a sextet that introduced the electronic jazz that would make him famous. He broke up the sextet in 1973 and formed a quartet that became the cornerstone of *Head Hunters.* From that time through the 1990's, Hancock alternated performing pure jazz, electronic jazz-rock, and pop-oriented music. His jazz-rock album *Future Shock* (1983) became a best seller. A song from the album, "Rockit," won a Grammy for best rhythm and blues instrumental. Hancock also composed for motion pictures and television. He won the 1986 Academy Award for his score for *'Round Midnight.* Frank Tirro

Hancock, John (1737–1793), was an American revolutionary leader who became the first person to sign the Declaration of Independence in 1776. His bold signature is still famous. Today, when people sign their names, they are said to have written their *John Hancock.*

Hancock was born on Jan. 12, 1737, in Braintree (now Quincy), Massachusetts. His father, a minister, died when John was a boy, and his uncle, Thomas Hancock,



The Museum of Fine Arts, Boston

John Hancock was an American revolutionary leader. The American artist John Singleton Copley painted Hancock's portrait in 1765.

one of the wealthiest merchants in Boston, adopted him. After his graduation from Harvard College in 1754, John joined his uncle in business. He inherited the company after his uncle's death in 1764.

Hancock became known as a revolutionary after an incident called the Liberty Affair in 1768. One of his vessels, the *Liberty,* arrived in Boston Harbor to unload a shipment of wine and take on new cargo. British customs officials seized the *Liberty,* charging that Hancock had disobeyed regulations. This action enraged the citizens of Boston. Mobs rioted, and the British government sent troops to restore order. The Liberty Affair became one of the events that led to the Revolutionary War.

In 1769, Hancock had won election to the Massachusetts General Court, the lower house of the colonial legislature. The General Court became the Massachusetts Provincial Congress in 1774, and Hancock served as its president in 1774 and 1775.

As tensions between the Americans and the British grew, Hancock used his wealth and influence in the movement for independence. His activities caused the British to regard him as one of the most dangerous revolutionaries. He and Samuel Adams, another Massachusetts leader, were nearly arrested by the British in 1775. But the famous ride by their fellow patriot Paul Revere gave them warning and enabled them to escape.

Ayer Collection, Newberry Library

The signature of John Hancock was the first signature placed on the historic Declaration of Independence at Philadelphia.

Hancock served as president of the Continental Congress from 1775 to 1777. As president, he was the first to sign the Declaration of Independence adopted by the Congress. Hancock hoped to command the Continental Army that fought for independence during the Revolutionary War. He was disappointed that the Congress chose George Washington. In 1778, however, Hancock led about 5,000 Massachusetts soldiers in an unsuccessful attempt to free Rhode Island from the British.

Hancock presided over the convention that adopted the Massachusetts Constitution in 1780, and he became the first governor under the new charter. He served nine terms as governor, from 1780 to 1785, and from 1787 until his death in 1793. William Morgan Fowler, Jr.

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Unger, Harlow G. *John Hancock: Merchant King and American Patriot.* Wiley, 2000.

Hancock, Winfield Scott (1824-1886), was a general of the Union Army in the Civil War (1861-1865). He also ran as the Democratic Party candidate for president of the United States in 1880, but James A. Garfield defeated him.

When the Civil War started, Hancock became a brigadier general of volunteers. He fought in the battles of the Peninsula, Antietam, Fredericksburg, and Chancellorsville. Promoted to major general, he helped select the battlefield at Gettysburg, where he skillfully commanded a corps and was wounded. He later served in the Wilderness campaign.

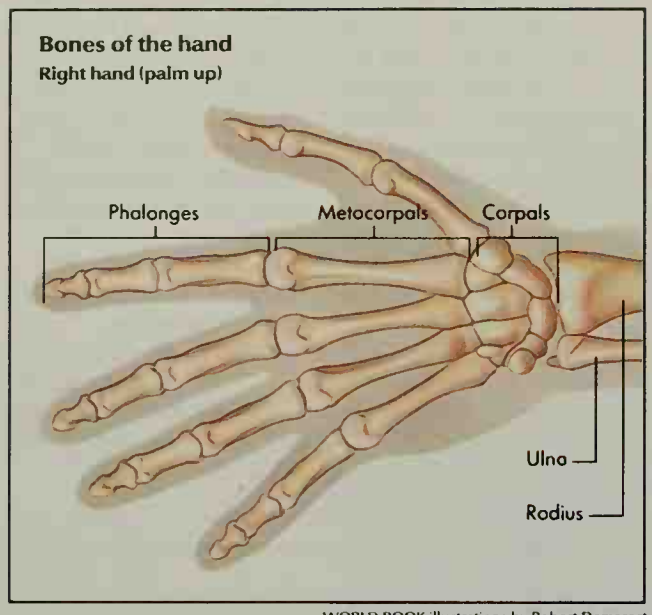
Hancock was born in Montgomery Square, Pennsylvania, and graduated from the U.S. Military Academy in 1844. He also served in the Second Seminole War (1835-1842); the Mexican War (1846-1848); and the Utah, or Mormon, War (1857-1858). John F. Marszalek

Hand is the end of a *forelimb,* or arm. Hands are specially constructed for taking hold of objects. True hands have *opposable thumbs,* or thumbs that can be moved against the fingers. This action makes it possible to grasp things in the hand and make many delicate motions. Human progress would have been hampered without the use of opposable thumbs. To help understand the work that thumbs do, try to pick up a pen while keeping your thumb motionless alongside your hand.

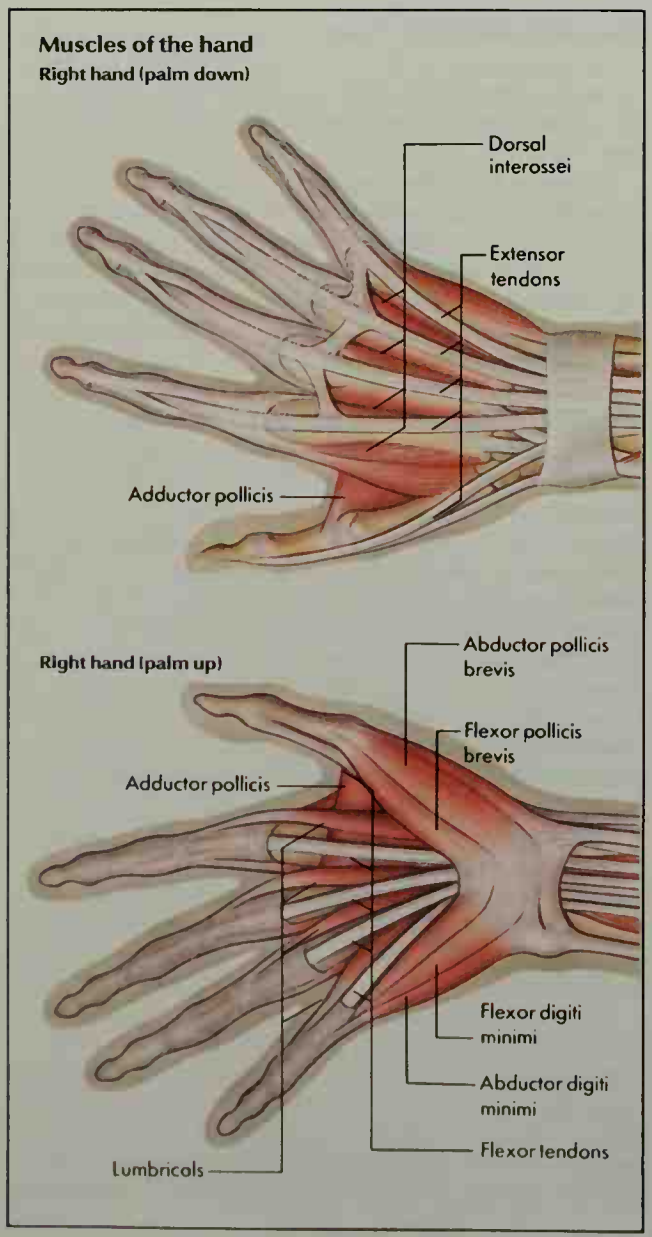
Hands are also used to touch and feel things. The human hand contains at least four types of nerve endings that make the fingers and thumbs highly sensitive. Blind persons rely entirely on their sense of touch when reading. They run their fingers over the raised letters of Braille books.

The human hand also helps people communicate with each other—as in the sign language of the North American Indians or that of deaf persons. In these sign languages, gestures and positions of the hand and fingers represent words or phrases. Hands convey familiar expressions and ideas. Well-known examples include the clenched fist of anger, the raised palm of peace, the

Anatomy of the hand



WORLD BOOK illustrations by Robert Demarest



"V" for victory or for peace, the "thumbs down" for disapproval, and the gesture for hitchhiking.

Parts of the hand. The human hand consists of the *carpals* (wrist bones), the *metacarpals* (palm bones), and the *phalanges* (four fingers and thumb). There are 27 bones in the hand. Eight carpal bones make up the wrist. They are arranged roughly in two rows. In the row nearest the forearm, starting from the thumb side, are the *scaphoid, lunate, triquetrum,* and *pisiform* bones. In the second row are the *trapezium, trapezoid, capitate,* and *hamate* bones. Five long metacarpal bones make up the palm. They connect the wrist with the fingers and thumb. Each of the four fingers contains three slender phalanges. But the thumb contains only two phalanges.

Thirty-five powerful muscles move the human hand. Fifteen are in the forearm rather than in the hand itself. This arrangement gives great strength to the hand without making the fingers so thick with muscles that they would be difficult to move. Near the wrist, the muscles become strong, slender cords called *tendons.* The tendons run along the palm and back of the hand to the joints of the fingers. When the muscles on the palm side of the forearm contract, the fingers close. When the muscles on the back of the forearm contract, the fingers open. Twenty muscles within the hand itself are arranged so that the hand and fingers can make a variety of precise movements.

Animal hands. In many animals, part of the forelimb corresponds to the human hand. These parts have the same basic arrangement of bones and muscles whether the animal uses them to dig, fly, swim, or run.

No animal "hand" has more than five digits. Animals have many kinds of "hands." The mole's short, chunky "hand" is ideally suited to act like a shovel in digging tunnels. The bat's forelimb is a wing, with a web of skin spread between the fingers. The bird's "hand" is also a wing. Phalanges and metacarpals support the wing. The seal's "hand" is its flipper. The bones have *fused,* or grown together, and they form a broad, flat paddle that is useful for swimming. The "hand" of the horse is constructed so that the animal stands on its middle finger. Through millions of years of development, the middle finger has become stronger and longer. This middle finger is well adapted to running. The horse's other fingers have become quite small or have disappeared.

J. Donald Opgrande

See also Carpal tunnel syndrome; Wrist.

Hand, Learned (1872-1961), an American lawyer and judge, served from 1924 to 1951 as judge of the United States Court of Appeals. He became known as one of the most able American judges. In his legal opinions, he preserved respect for legal institutions. But at the same time, he helped mold the law to fit changing times. Hand's opinions won respect because of their insights and also because of their careful construction.

Hand was born in Albany, New York, and graduated from Harvard University. He practiced law in Albany and New York City from 1897 to 1909. He was appointed to the United States District Court, for the southern district of New York, in 1909, and to the United States Court of Appeals in 1924. David M. O'Brien

Hand grenade. See Grenade.

Hand organ is the general name given to several kinds of musical instruments that produce music when

the player cranks a handle. The most common kind is the *barrel organ,* or *piano organ,* played by street musicians. The instrument consists of a box that contains pipes or metal reeds and a cylinder, called a *barrel,* on which pegs are arranged. When the barrel is turned by a crank, the pegs open the valves of various pipes. This action forces air into the open pipes to produce music.

The *hurdy-gurdy* is a kind of hand organ with strings that is seldom played today. Most hurdy-gurdies have from four to six strings. The instrument is played with keys and a rosin-covered wooden wheel. The keys determine the notes that are played. The wheel, turned by hand, rubs the strings to create the music. The hurdy-gurdy was popular in Europe during the 1000's and again during the 1700's. Melvin Berger

Handball is a game in which players hit a rubber ball against a wall with their hands. Each side tries to hit the ball in such a way that the other side cannot return the ball to the wall. A handball game in which two people oppose each other is called *singles.* Four people can form two teams and play *doubles.* Handball players use a hard, hollow ball that is 1 $\frac{7}{8}$ inches (4.8 centimeters) in diameter. The ball should weigh 62 grams (2.19 ounces), but balls between 61 and 63 grams (2.15 to 2.22 ounces) are permitted. A ball lighter than 61 grams may be used if it receives official approval.

Handball is played on courts with four walls, three walls, or one wall. *Four-wall handball* is the most popular form. A standard four-wall court is 20 feet (6 meters) high, 20 feet wide, and 40 feet (12 meters) long. Its back wall must be at least 14 feet (4.3 meters) high.

One player starts a four-wall handball game as the *server.* The server stands in the *service box* (a zone 5 feet, or 1.5 meters, wide near the middle of the handball court). The server drops the ball on the floor and strikes it with one hand on the first bounce, driving the ball against the front wall. The ball must strike the front wall of the court before hitting the floor or ceiling or another wall. After hitting the front wall, the ball must bounce back over the *short line* (center line across the width of the court). The serve may hit one side wall after hitting the front wall, but must go over the short line before it hits the ground. A serve that falls in front of the short line is a *short,* and the server serves again. If the server hits another short, the serve is considered an *out,* and the other team takes over the serve. The receiver or receivers must stand behind the *restraining line,* which is 5 feet (1.5 meters) behind the short line, until the server strikes the ball. The server receives a point if the receiver violates the rule.

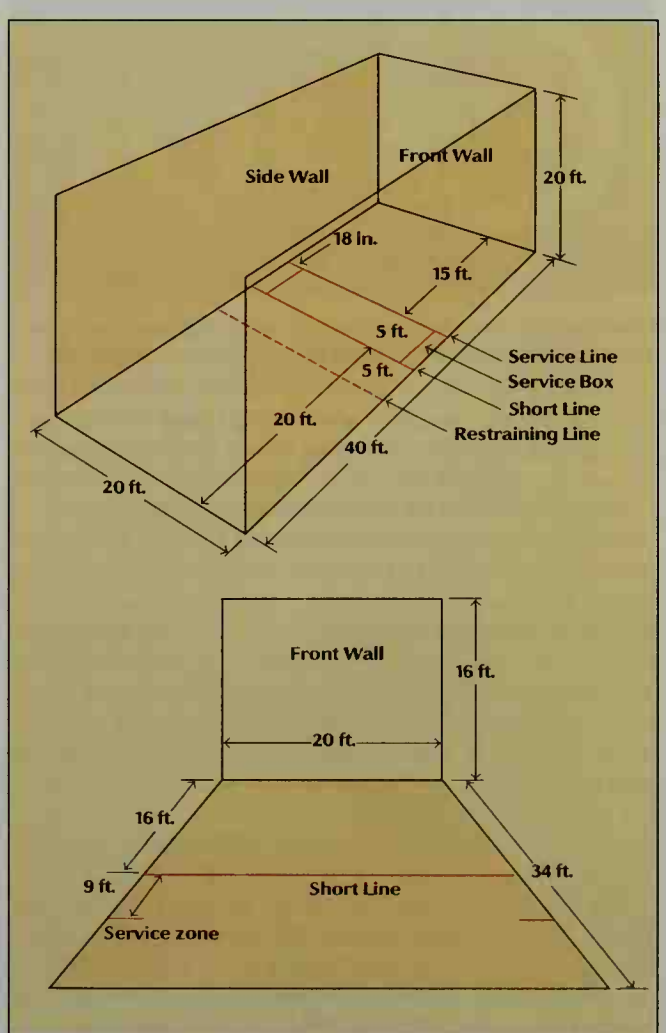
After a serve comes over the short line properly, the server's opponent hits the ball if possible. The players or teams then take turns hitting the ball to the front wall until one of them fails to return the ball before it bounces twice on the floor. Players cannot *hinder* (block) each other from hitting the ball. In returning a ball, a player can use a combination of side walls or ceiling with the front wall, or can hit the ball directly into the front wall. If the server misses a returned ball, the serve is lost. If the opponent misses, the server scores 1 point and serves again. The first side to score 21 points wins the game. A *match* usually consists of the best two out of three games.

Three-wall handball has the same playing area and rules as four-wall, but there is no back wall. Some three-wall courts have ceilings.

One-wall handball is usually played outdoors. A standard court is 20 by 34 feet (6 by 10 meters). Its wall is 20 feet (6 meters) high.

Team handball is played by two teams of seven players each. The court has no walls and is much larger than

© Peter Gonzalis



A handball court with glass walls allows spectators to watch. The drawings shown give the dimensions for three- and four-wall courts, *top,* and for a one-wall court, *bottom.*

the court used in court handball. The ball is about the size of a small soccer ball. See Team handball.

Drawings made by Egyptians thousands of years ago show people playing a game similar to handball. The type of handball that is played today probably originated among the Basque people of Spain. The U.S. Handball Association was set up in 1950 to help promote the game. Its headquarters are in Tucson, Arizona.

Critically reviewed by the United States Handball Association

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Handcuffs are used by law enforcement officers to prevent a suspect or prisoner from having full use of the hands. Most handcuffs consist of a pair of steel rings connected by a short chain. The rings fit over a person's wrists and can be adjusted to fit wrists of different sizes. One end of each ring has jagged edges that slip into the other end and lock automatically. Such handcuffs are opened with a key.

Another kind of handcuff is a 22-inch (56-centimeter) strip of inexpensive flexible plastic. One end is slipped through a slit at the other end. A small steel hook near the slit locks the ends together. These handcuffs are removed by cutting them off.

E. R. Degginger

Handcuffs commonly consist of two metal rings connected by a chain. They are designed to limit a person's hand movement.

In ancient times, handcuffs were called *shackles* or *manacles.* They were used either as a form of punishment or as a method of fastening both the hands and feet of a suspect or prisoner. Charles F. Wellford

Handel, George Frideric (1685-1759), was a German-born composer who is known today mainly through his musical compositions called *oratorios.* His famous oratorio *Messiah* is one of the most popular works in music. In the mid-1900's, Handel's operas, neglected for 200 years, gained recognition as at least equal in quality to his oratorios. Handel also composed much orchestral music, *chamber music* (music for small groups of instruments), and solo music for harpsichord.

His life. Handel was born in Halle on Feb. 23, 1685. He began taking music lessons at the age of 7. By the time he was 12, he was assistant organist at the Halle cathedral. As a youth, he had a typical Lutheran education and studied law at the University of Halle for a year. His first activity as a composer began in 1703 in Hamburg, then a center of French, Italian, and German operatic styles.

Between 1706 and 1710, Handel worked in Italy, becoming one of the most popular composers of Italian opera. He moved to England in 1712 and lived in London until his death. He is buried in Westminster Abbey.

Italian opera was still quite new to England when Handel arrived, and it gained its greatest popularity among the nobility during his early years there. Then the flourishing middle class flocked to the English ballad operas, and the nobility turned to the lighter and often comic operas of the younger Italians.

In 1741, Handel abandoned opera and dedicated himself to composing oratorios. *Messiah* was the first of the oratorios that followed. In 1751, after completing *Jephtha,* Handel gave up composing because of blindness. But he remained active. He conducted a Holy Week performance of *Messiah* the day before he died.

His work. The oratorio developed in Italy as a music drama to be played without staging in the *oratory* (meeting room) of a religious association. Singers represented characters in a Biblical story or in the life of a saint. In addition to the dialogue and songs of the singers, a narrator often filled in necessary details in the story. A chorus usually represented groups of people or crowds and reacted to the events.

Handel composed more than 25 oratorios. His first, *La Resurrezione* (1708), was composed during his stay in Italy and is the only one with an Italian text. In 1717, after settling in England, he turned again to the oratorio, writing to English texts. He based most of them on Biblical stories. *Messiah* is an exception. The text is a collection of quotations gathered by Handel's friend Charles Jennens from the Bible. *Messiah* contains no dramatic action. It illustrates the foundations of Christianity in a series of musical numbers that parallel the prophecy of Christ's coming, His birth, life, death, and resurrection.

The solo singers' music in Handel's oratorios was written in the manner of Italian opera of that time. The choruses often use the style of the sacred anthem. Most of Handel's oratorios were first performed in theaters. Audiences paid admission as they would to an opera. *Messiah* was first heard in a theater in Dublin in 1742.

The main reason for the popularity of *Messiah* lies in its glorious choruses, which show a remarkable variety of mood and technique. "And the glory of the Lord" is a happy dancelike chorus in triple time. The voices come in and out casually and also join in resounding exclamations. In "And He shall purify," four voice parts alternately sing the theme. "O thou that tellest good tidings" recalls earlier English music, particularly that of Henry Purcell, in its melody, lightness, and good cheer. In "Surely he hath borne our griefs," Handel portrayed grief with solemn rhythms and thick harmony. The thrilling "Hallelujah" chorus shows Handel as a master of choral effects.

Saul (1739), Handel's most dramatic oratorio, is more typical of Handel's approach to the oratorio. Jennens's words represent the conflict between Saul, king of Israel, and David, the youthful warrior who slew Goliath. The action develops during the sections of speechlike song called *recitative.* These sections are usually accompanied only by a harpsichord and violoncello. The characters express their anger, hope, love, delight, joy, and other emotions in lengthy *arias* (solos) accompanied by

orchestra. The reasons for these emotional outbursts are brought out in the recitative. The two types of music alternate unless a chorus or symphony breaks in. The arias often rely on the *da capo* formula. In this formula, the first section, based on one theme, returns after a middle section based on a similar or a contrasting theme.

Few of the choruses of *Saul* are of the meditative, anthemlike variety of *Messiah.* They tend to be shorter and more direct. Like the chorus of Greek tragedy, they provide emotional reactions to dramatic events. Sometimes they point out a moral.

Handel's more than 40 operas were mostly written before *Saul.* Modern productions of his operas *Julius Caesar* (1724), *Orlando* (1733), and *Alcina* (1735) demonstrate that they are still stageworthy and appealing, filled with melodic invention and emotional variety. They have earned Handel a place among the world's great dramatic composers.

Handel wrote more than 150 instrumental compositions. The best known of these include two orchestra suites, *Water Music* (about 1717) and *Royal Fireworks Music* (1749). Handel composed many harpsichord suites, organ concertos, and sonatas for chamber groups. He also wrote a number of *concerti grossi,* compositions that feature a small group of soloists with a string orchestra. Darrell Matthews Berg

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Handgun is a firearm that can be operated with one hand. Other types of guns, such as rifles and machine guns, require the use of both hands, a *tripod* (three-legged stand), or a shooting rest.

Handguns are carried primarily by the police and by the armed forces. But in the United States, private citizens own about 100 million handguns, and about 1 million are owned by private citizens in Canada. Some citizens use handguns for target shooting, hunting, or protection. Others collect antique or classic handguns. Unfortunately, thousands of handgun-related deaths occur in the United States, Canada, and many other countries each year. These deaths include suicides, homicides, self-defense killings, and accidents.

Parts of a handgun

Handguns vary in appearance, size, type of ammunition used, and method of operation, but they all include the same basic parts. These parts are the *frame,* the *grip,* the *barrel,* the *sights,* and the *action.*

The frame is the main body of the gun that connects the other parts. The grip is the handle of the gun, and the barrel is the metal tube through which the bullet is fired. The *lands* and *rifling* (grooves) are alternating raised surfaces and channels inside the barrel. They cause the bullet to spin and thus make it travel in a direct path.

The shooter uses the sights to line up the handgun with the target. Some sights can be adjusted to help aim the gun more easily. All handguns made for target shooting have adjustable sights.

The action includes the main working parts of the handgun. It consists of such parts as the trigger, the hammer, and the cartridge chamber. The type of action determines how the handgun is loaded and fired. The action of every handgun includes a *safety,* a mechanism that prevents the gun from firing unintentionally. The safety ensures that the gun fires when the shooter squeezes the trigger, but not, for example, when the gun is dropped to the ground.

Types of handguns

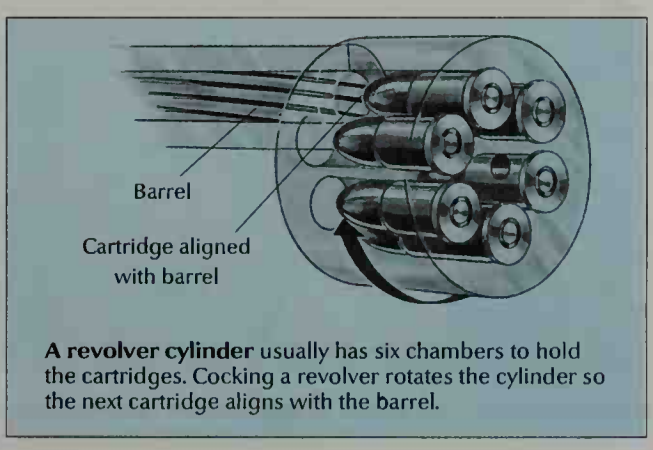
There are five main types of handguns: (1) single-action revolvers, (2) double-action revolvers, (3) single-action semiautomatic pistols, (4) double-action semiautomatic pistols, and (5) single-shot pistols. Revolvers carry ammunition in chambers in a rotating cylinder. Most pistols are loaded with a *magazine* containing the ammunition. The magazine is a metal holder inserted in the gun's *butt* (thicker end).

Single-action revolvers typically hold six cartridges. An arm near the hammer rotates the cylinder one-sixth of a turn when the hammer is cocked. This movement puts a cartridge into line with the barrel and the *firing pin* (part that strikes the primer to fire the cartridge). After cocking the hammer, the shooter pulls the trigger. The hammer unlocks and falls, exploding the cartridge. The Colt single-action Army revolver, first produced in the 1870's, is the most famous firearm of this type.

Double-action revolvers, like single-action revolvers, typically hold six cartridges. But, unlike single-action revolvers, double-action revolvers do not require the user to manually cock the hammer before firing. Instead, the gun is fired by only pulling the trigger. When the trigger is pulled, a lock that holds the cylinder in place is released, revolving the cylinder and cocking the hammer. When the next chamber is lined up with the barrel, the cylinder locking bolt is raised into the locking notch, securing the cylinder. The hammer then falls and fires the cartridge. The cycle is repeated for the next shot.

The main advantage of the double-action revolver over the single-action revolver is that it can be fired rapidly. The Smith & Wesson military and police revolver is one of the most popular double-action revolvers. This firearm was introduced in 1905.

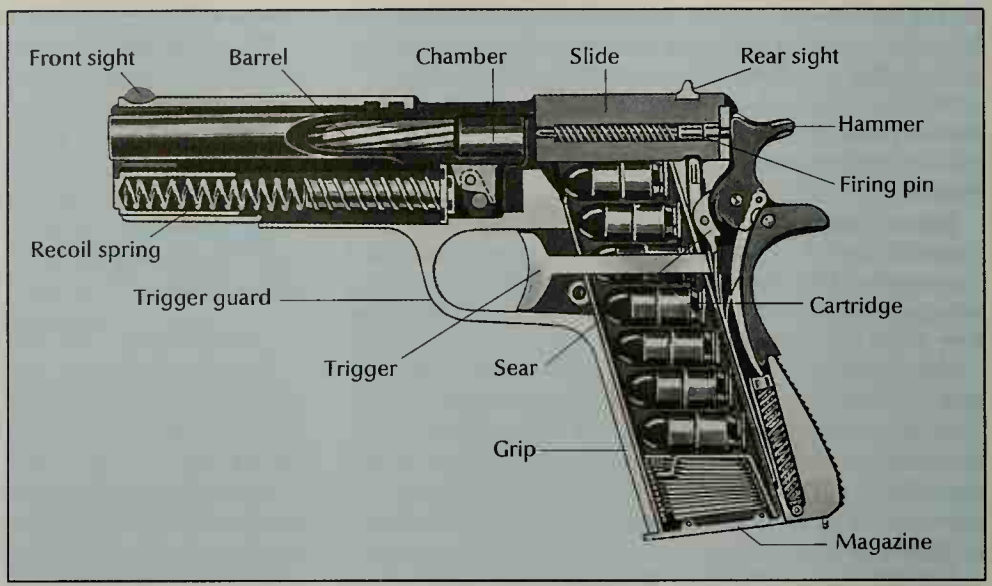
Single-action semiautomatic pistols are fired by first pulling back a device called a *slide* to cock the ham-



A revolver cylinder usually has six chambers to hold the cartridges. Cocking a revolver rotates the cylinder so the next cartridge aligns with the barrel.

How an automatic handgun works

The Colt .45 automatic pistol is used primarily for personal defense. This weapon is fired by first pulling the slide and barrel to the rear to cock the hammer. Releasing the slide feeds the cartridge into the chamber and returns the barrel to the firing position. When the trigger is squeezed, it presses against the sear, which in turn releases the hammer. As the hammer falls, it strikes the firing pin. The firing pin flies forward, striking the primer of the cartridge and exploding it. Recoil drives the barrel and slide to the rear, automatically cocking and loading the pistol for the next shot.



WORLD BOOK diagram

mer or the firing pin, sometimes called a *striker mechanism*. When the slide is released, it moves forward and feeds a round from the clip into the cartridge chamber. When the shooter pulls the trigger, the hammer falls or the striker mechanism is released, impacting the primer and exploding the gunpowder in the cartridge. The explosion causes the slide to move backward. This *recoil* automatically ejects the empty cartridge and recocks the gun. When the slide moves forward again, it reloads the chamber. The most famous single-action semiautomatic is the Colt .45 automatic pistol. It served as the standard sidearm of the United States armed forces from 1911 until 1985.

Double-action semiautomatic pistols operate somewhat like double-action revolvers. When the trigger is pulled, the hammer goes through the firing cycle and fires the cartridge. After the initial shot, the pistol begins to operate like a single-action semiautomatic pistol. The recoil of the first shot forces out the empty cartridge case, cocks the hammer, and inserts a new cartridge from the clip into the cartridge chamber. Double-action semiautomatics are widely used by sports enthusiasts and police officers. In 1985, the 9-millimeter Beretta, a double-action semiautomatic pistol, became the standard sidearm of the U.S. armed forces. Other popular models include the Smith & Wesson Model 39 and the Walther PPK.

Single-shot pistols are used chiefly in international target-shooting competitions. To load a single-shot pistol, the user moves the *operating lever* (part that opens and closes the action) forward and down to lower the *breech block* and to cock the firing pin. The breech block closes the *breech* of the gun—that is, the part behind the barrel. After the breech block has been low-

Some historic handguns

Since handguns first appeared in the 1400's, certain models have become well known because of their special features or wide use. Some of these handguns are shown here.

Roger Roland Fuhr, ROLANDesign, Los Angeles

English wheel lock (1640)

English belt flintlock (1800)

First Colt (1835)

Colt Walker (1847)

Derringer (1855)

Single-action Army revolver (1873-1940)

German Luger (1914)

Military and police semiautomatic used today

ered, the cartridge chamber is exposed. The user then inserts a cartridge into the chamber. Next, the operating lever is pulled up and back to close the chamber and move the cartridge into the closed position. The pistol is then ready to fire. When the trigger is pulled, the firing pin drops, exploding the cartridge. The procedure is then repeated to remove the cartridge and reload the pistol. Famous single-shot pistols include the Hammerli Free Pistol, the Walther, and the Martini.

History

Early handguns. The first gun operated with one hand was the matchlock gun, which appeared in the 1400's. It was fired by attaching a burning cord or match to an S-shaped holder called a *serpentine*. In the early 1500's, the wheel-lock gun was invented. Its metal wheel struck a spark when it revolved against a piece of pyrite. With the wheel lock, soldiers no longer had to carry flames to ignite the gunpowder.

During the mid-1500's, snaphance pistols, which were easier to operate than the wheel lock, came into widespread use. In the 1600's and 1700's, many kinds of gunlocks were developed, including the flintlock (see **Flintlock**).

In 1807, Alexander Forsyth, a Scottish inventor, introduced the percussion system. Percussion-system pistols were loaded from the muzzle, with a sliding can of priming powder on the breech. Small handguns known as derringers are descended from percussion-system pistols, but are breech loaded. They are named for Henry Deringer, Jr., a United States pistol maker of the 1800's.

Rapid-fire handguns. One of the first practical revolvers was the Colt Paterson, patented in England in 1835 by Samuel Colt, a U.S. inventor. In 1857, the U.S. inventors Horace Smith and Daniel Wesson began producing revolvers that used cartridges.

The Borchardt, the first self-loading semiautomatic pistol, appeared in 1893. It had an eight-cartridge clip placed in the hollow of the grip. George Luger, an Austrian-born inventor, improved the Borchardt in the early 1900's. In 1897, John M. Browning, a U.S. inventor, patented an automatic pistol that became the basis for later automatics, including the Colt .45.

Jeffrey Scott Doyle

Related articles in *World Book* include:
Ammunition
Browning, John M.
Bullet
Cartridge
Colt, Samuel
Firearm
Gun
Gun control

Handicap is a way to equalize sports competition between opponents who are unequal in ability. Handicaps include scoring bonuses and weight allowances.

Handicapped. See Disabled.

Handicraft, also called *handcraft,* refers to the creation of objects by hand. The range of handicrafts is limited only by an individual's imagination and ability. Handcrafted objects include boxes, bowls, lamps, wall-hangings, toys, rugs, picture frames, leaded glass windows, baskets, moccasins, and boats.

Handicraft materials include wood, leather, cork, plaster, metal, fabric, yarns, beads, reeds, and shells. Most handicrafts require the use of such tools as hammers, needles, sewing machines, weaving looms, glass cutters, knives, or scissors. Traditional handicrafts, including basket weaving and pottery making, use natural materials and simple tools. Modern handicrafts, such as plastic sculpturing or model making, use industrial materials and techniques.

People create handicrafts for a number of reasons. Many people learn craft skills as a challenging and entertaining hobby. They may also enjoy expressing themselves artistically as they create objects. Other people get satisfaction from making the things they need in everyday life. Often craftworkers design and make original objects to exhibit and sell. Doctors sometimes recommend handicrafts as therapy for people who have emotional problems or physical disabilities (see **Occupational therapy**).

The earliest handcrafted objects may have been items that people cut from wood with sharpened stones. Handcrafting served as the only method of creating objects for thousands of years.

The Industrial Revolution of the 1700's and early 1800's brought about great changes in the way objects were made. People using machines could make items much faster and cheaper than could individuals working by

Frank Siteman, Taurus

Weaving colorful fabrics is a popular handicraft throughout the world. This woman is weaving a place mat on a hand loom.

Mary Heitner, Taurus

A potter uses the fingers to shape wet clay as it is spun around on a mechanical device called a *potter's wheel.*

hand. The mass production of goods reduced the demand for homemade items, and handicrafts became a hobby rather than a necessary activity.

After World War II (1939-1945), a new interest in handicrafts emerged. By the late 1950's, many people had become disenchanted with mass-produced goods. They disliked the sameness and lack of artistic design they saw in many mass-produced objects. In response to this dissatisfaction, manufacturers produced handicraft kits that provided precut parts and instructions showing people how to make various items.

As public interest increased, schools and colleges began to teach crafts. Educators came to recognize that creating a crafted object requires many of the same artistic skills and design knowledge as the fine arts.

Dona Z. Meilach

See also the articles on *Handicraft hobbies* listed in the *Related articles* of the **Hobby** article.

Handkerchief, *HANG kuhr chihf,* is a small piece of cloth people carry to wipe their face, nose, or eyes. It is usually made of cotton or linen, but it may be of lace or silk. The people of ancient Greece and Rome used the first handkerchiefs we know about. During the Middle Ages (from the A.D. 400's to 1500), the handkerchief became a showy decoration. In France during the 1000's, wealthy men and women wore their handkerchiefs hanging from their belts.

As the use of the handkerchief spread, each nation developed its favorite materials. The French used silk and linen; the Italians, lace; and the English, cotton or silk. Today, the best linen handkerchiefs are made in Northern Ireland and Scotland in the United Kingdom as well as in Belgium, France, and Switzerland. The best cotton handkerchiefs are from France and Italy. The best silk varieties are from China and Japan.

Lois M. Gurel

Hands. See Hand.

Handsome Lake (1735?-1815) was a Seneca Indian religious leader. His teachings helped the Seneca and other Iroquois tribes adapt their traditional beliefs to life after the Revolutionary War in America (1775-1783), as they struggled to rebuild their homes and adjust to the loss of most of their lands. Handsome Lake's teachings remain important to many Iroquois people today.

Handsome Lake was born near what is now Avon, New York. His original name is unknown. In the 1790's, he became a chief of the Iroquois League, a confederation of six Indian nations. He then assumed the title Handsome Lake—in the Seneca language, Ganeodiyo. Other spellings of the name include Skanyadariyoh and Ganiodaiio.

In June 1799, Handsome Lake fell into a coma, then awoke and described a visit from messengers sent by the Creator. This was the first of three major visions that revealed to him the *Gaiwiio,* which means *Good Message* or *Good Word.* In this message, Handsome Lake warned that Indians must give up alcohol, witchcraft, and other practices that threatened family and community solidarity. They must revive their ancient cycle of annual ceremonies if they were to survive as a people.

Handsome Lake also encouraged the use of European farming methods and tools, including the plow and the spinning wheel. He died during a visit to the Onondaga Reservation in central New York, where he is buried.

Daniel K. Richter

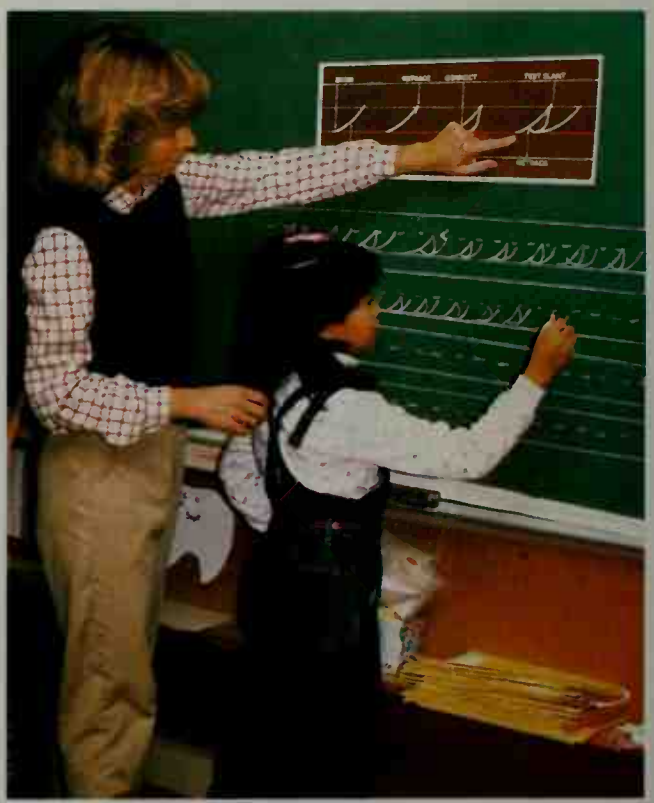
Handwriting is one of the most useful skills. A person who has learned to write can put thoughts on paper for others to read. Handwriting plays a vital part in communication, and is one of the most important ways of keeping ideas ready for use. People can forget. But handwriting helps them remember. They can use pen or pencil to mark down letters, numbers, and other signs. People can move to another town, city, or country, but handwriting lets them "talk" to one another. The art and practice of attractive handwriting is called *penmanship,* or *calligraphy* (see **Calligraphy**).

The importance of handwriting

Some people believe that typewriters, computers, and printing presses have made handwriting unimportant. However, it is still a necessary skill for everyone. When people write letters, they may want to write about their own ideas and feelings, or about their friends and families. A handwritten letter has a personal touch, because no two individuals have exactly the same handwriting.

Handwriting has other important uses. Students use handwriting to record and organize ideas they hear in lectures and classrooms. Later, they can use their notes for study and discussion. Secretaries of clubs usually write down important happenings at meetings. In school, students often write reports and tests by hand. Business executives, doctors, teachers, and many other adults keep records and make notes by hand. Later, they may have these ideas typewritten or printed.

Just being able to write is not enough. A person must also write *legibly,* so the words can be read. Handwriting that no one can read is useless and can create seri-



© Jim Cronk

Learning to write is one of the most important parts of education. This teacher is showing a student how to write correctly.

ous problems. For example, a student may write the correct answer to a question on a test. But if the teacher cannot read the answer, it may be marked wrong. An unclearly written check may result in serious financial loss. If a clerk writes a sales ticket so that the person delivering the package cannot read the ticket, it may delay the delivery and produce a dissatisfied customer.

Kinds of handwriting

In most schools, students are taught two kinds of handwriting—*manuscript writing* and *cursive writing.* Some writing systems combine manuscript and cursive letter forms for beginning writers. For details, see the *Handwriting Systems* section in this article.

Manuscript writing is a kind of handwriting most often learned by schoolchildren who are just beginning to write. It looks much like printing in a book. Each letter is straight up-and-down, and not joined to the next. Here is an example of manuscript writing:

Handwriting is an important skill in modern living.

Teachers find that learning to write is not always easy for young children. Most teachers prefer a way of writing that places as little strain as possible on a child's first efforts to put ideas down on paper.

Young children find manuscript easier to learn than cursive writing, the more difficult method used by adults. Manuscript writing is easier, chiefly because it makes only limited demands on the ability to use arm, hand, and eyes together effectively. Young children can easily make the simple curves and straight lines of manuscript letters. They can learn clear, easy-to-read handwriting quickly.

Manuscript also comes naturally from a young child's experiences with printed words. A youngster usually begins to do some reading before learning to write. Children read their teacher's manuscript writing on the chalkboard. In books, they read printed words that look much like manuscript words. So they know the letters with which they begin their own manuscript. At the same time, learning manuscript helps them learn to read and to spell. By the time children begin cursive writing, usually they can write fairly well in manuscript.

Cursive writing is used by most adults. Boys and girls usually learn cursive writing after they have mastered manuscript writing. The word *cursive* means *running.* In cursive writing, the letters join, or run together, instead of being separated as in manuscript. Also, the letters are slanted. Here is an example of cursive writing:

Handwriting is an important skill in modern living.

Some people use both manuscript and cursive writing. They may use manuscript to make signs, labels, and charts. They use cursive writing for their personal letters and notes.

Learning to write

Beginners should aim for easy-to-read handwriting. At the same time, they should try to attain a fair degree of speed. But teachers advise caution in trying to gain speed. Too much pressure to increase speed may hamper both clear writing and careful thinking.

Writing readiness. Children usually begin to learn to write in kindergarten or first grade. Sometimes children learn some handwriting even before entering school. If so, parents or teachers should make sure that children learn in the same way they will learn later in school. Also, they should be sure that the child is ready to learn.

A strong interest in writing is one of the most important signs of a child's readiness to learn to write. This interest often results from seeing adults and other children write at home and in school. But interest is not enough. Eye, hand, and arm control must be developed so that the child can manage paper and pencil. Coloring, drawing, and many kinds of play help build control. Puzzles, nesting toys, lacing frames, and similar playthings can help. A child also needs a strong sense of left and right. Otherwise, reverse writing or other problems may occur. Games and simple dances help develop a sense of left and right. Most of all, the child must want to say something on paper and must be able to read what was written down. A child's readiness to read is usually an important clue that readiness to write will soon appear (see **Reading**).

Learning manuscript writing. When handwriting instruction begins, teachers usually encourage boys and girls to express their own ideas in writing. This kind of learning is called *functional,* because it puts handwriting to work at once. Teachers hold practice periods on letters only as long as necessary. These practice periods help students learn the different shapes and strokes required for letters.

In this kind of learning, children sometimes use oversized pencils. But many handwriting experts believe that ordinary pencils serve just as well. The writing paper has lines 1 inch (2.5 centimeters) apart. Halfway between these lines, there may be lines of another color, or dotted lines, that help in writing both capital and *lower case* (small) letters. Often, the teacher writes model letters on the chalkboard for the children to practice. The students may practice new letter shapes and words on the chalkboard before trying them on paper.

The opportunity to watch the teacher write is important in learning manuscript writing. The teacher shows in clear, easy-to-follow strokes just how to write. Each letter is made with the same strokes in the same order every time it is written. The teacher may use the same words each time to name the strokes for the students. For example, when making the letter *"a"*, the teacher may say, "Around, straight down." In general, the curves and straight lines that make up the letters are made from the top of the letter downward. The children learn to check the shape, size, and spacing of the letters.

The child should hold the chalk or pencil in a way that fits the hand naturally. No two children can hold pencil or chalk exactly alike. Some have hands that are long and thin. Others have short, wide hands. The paper is placed straight up-and-down for manuscript writing. For cursive writing, the paper slants to the left for people who are right-handed. For left-handed people, the paper slants to the right. The child should sit up straight, squarely in front of the table or desk, with both feet flat on the floor.

Learning cursive writing. Children should make the shift from manuscript to cursive writing only after they have gained a fair mastery of manuscript. The change usually occurs in the late second or third grade. In some cases, a later time makes the shift less difficult. At any grade level, the shift should be made gradually. It may require an average of four to six weeks. But children with varying abilities should be permitted considerable difference in the required time.

Learning cursive writing once consisted of practicing individual letters. Children practiced until they could make an exact copy of the letter from the chart, manual, or chalkboard. Today, the goal is still the development of clear, well-formed letters. But the child begins writing stories and reports soon after learning the letters. In this way, the child makes practical use of writing skills as soon as possible instead of delaying while striving for perfect letter shapes.

As in manuscript writing, students learn the most about cursive writing by watching a teacher write well. They can see how the paper is slanted to give slant to the writing. They learn which letters are made differently in cursive writing than in manuscript. The students also learn how to make the joining strokes between letters. They are taught not to raise the pencil from the paper until an entire word is finished. Then, they dot the "i's" and cross the "t's."

Handwriting systems. Teachers can use one of several systems to teach handwriting. Materials for these systems are prepared by various companies.

Since the mid-1900's, some companies have developed writing systems that combine manuscript and cursive letter forms for beginning writers. One of the best-known systems combining letter forms is *D'Nealian handwriting,* which was introduced in 1978. D'Nealian manuscript letters are oval and slanted. They more closely resemble cursive writing than conventional manuscript. This resemblance is intended to make cursive writing easier for children to learn. D'Nealian cursive letters look like those of other writing systems.

Research concerning handwriting techniques has shown no evidence that one particular system of hand-

Handwriting There are two chief kinds of handwriting, manuscript and cursive. Several systems have been developed to teach each kind to beginning writers. A traditional system appears below. A newer system, called D'Nealian, is shown on the opposite page.

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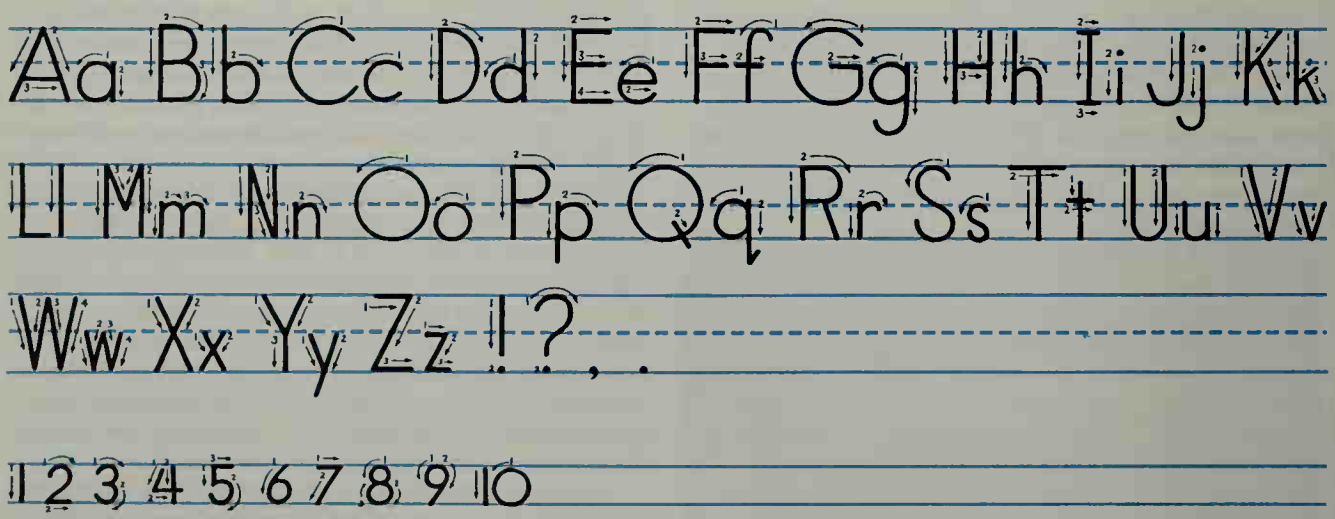
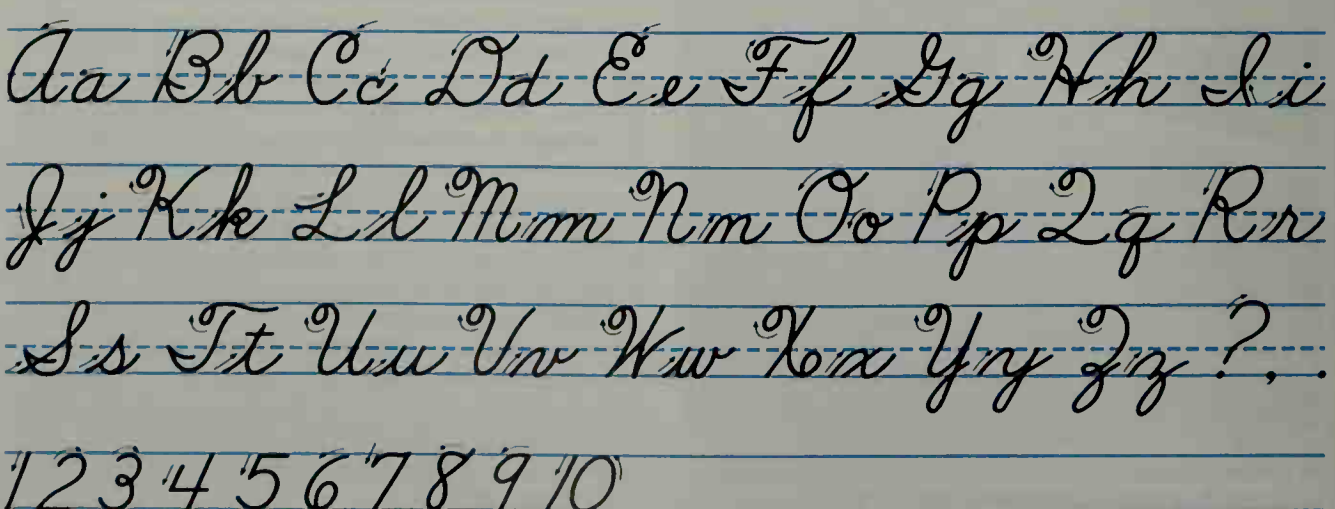
Traditional manuscript



Traditional cursive



writing is better than any other. Researchers have concluded that the individual instructor's skill plays the most important role in teaching a child to write.

Left-handedness. About 10 per cent of all people are left-handed. When left-handed children begin to learn to write manuscript, they may need some special help from the teacher. A left-handed child should hold the pencil so that the fingers are at least 1 inch (2.5 centimeters) from the point. This grip gives the child a better view of the paper while writing. Sitting at a desk or table that is slightly lower than normal height also may help. Left-handed children should be encouraged to keep the left arm close to the body when writing.

A left-handed child learning cursive writing may place the writing paper toward the left side of the desk, turned in a clockwise direction. Because it is difficult for left-handed children to slant their writing to the right, they should be allowed to write without a slant or to slant their writing to the left.

Teaching methods for left-handed children may include group lessons with a left-handed person demonstrating the writing technique. Practicing at the chalkboard also may be useful.

Common handwriting problems

The main goal for easy-to-read handwriting consists of good letter formation. The letters *a, e, r,* and *t* seem to cause difficulty. But in all letter forms, a few strokes determine whether or not a letter will be clear. Too much spacing between letters and irregular slanting of letters may also result in poor handwriting.

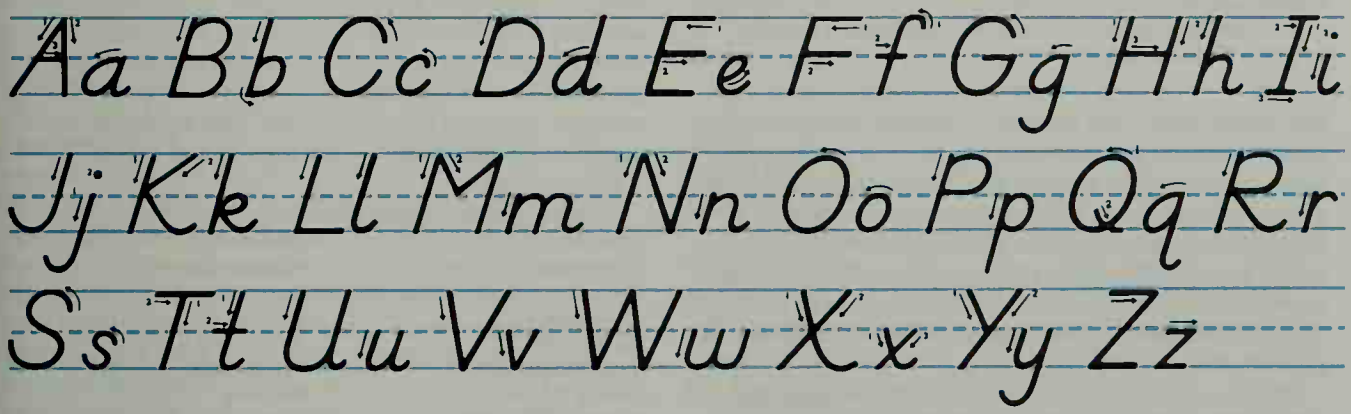
In general, a person who wants improved handwriting should correct these common problems. But someone may have to help the person find the difficulties and correct them in the right way.

History

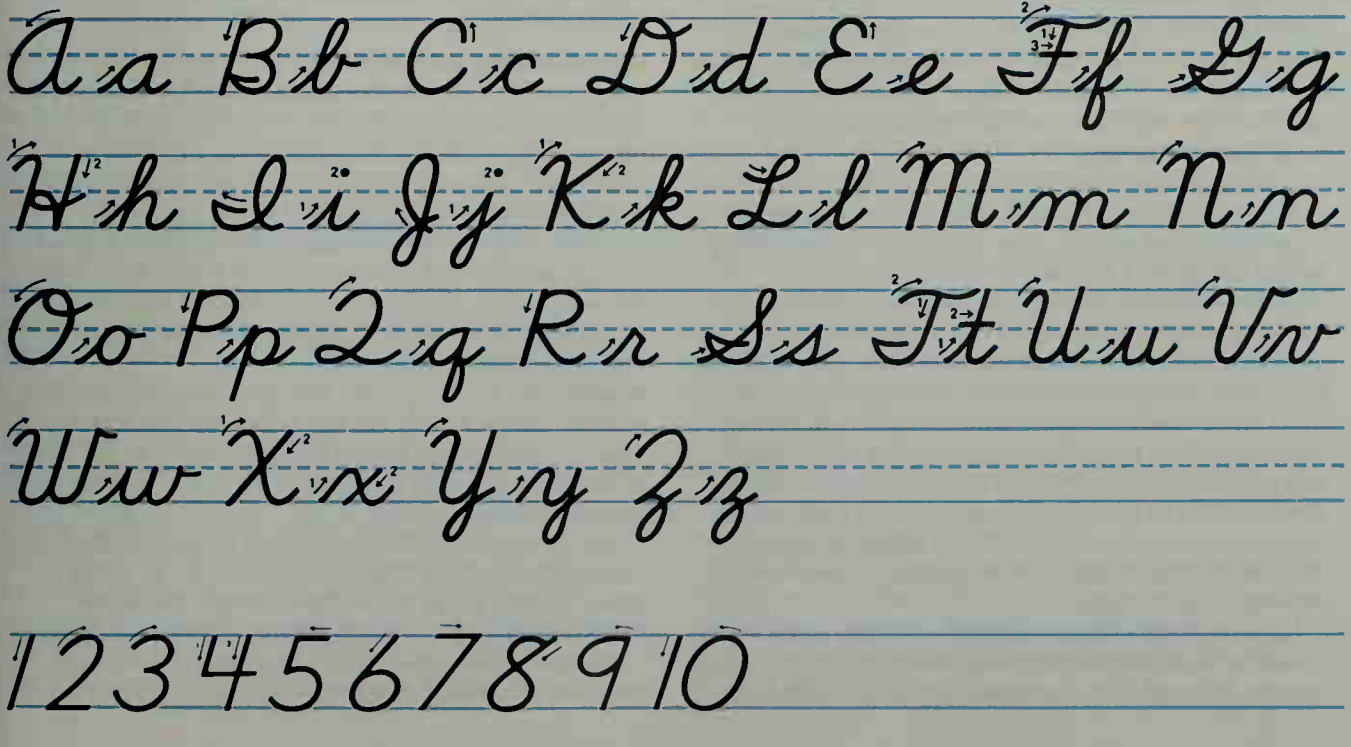
Early forms of writing. Prehistoric people invented the first crude "writing." They drew pictures of wild animals on the walls of caves and rock shelters. Their pictures tell the story of how they hunted for food (see **Prehistoric people**). Later peoples made their pictures sim-

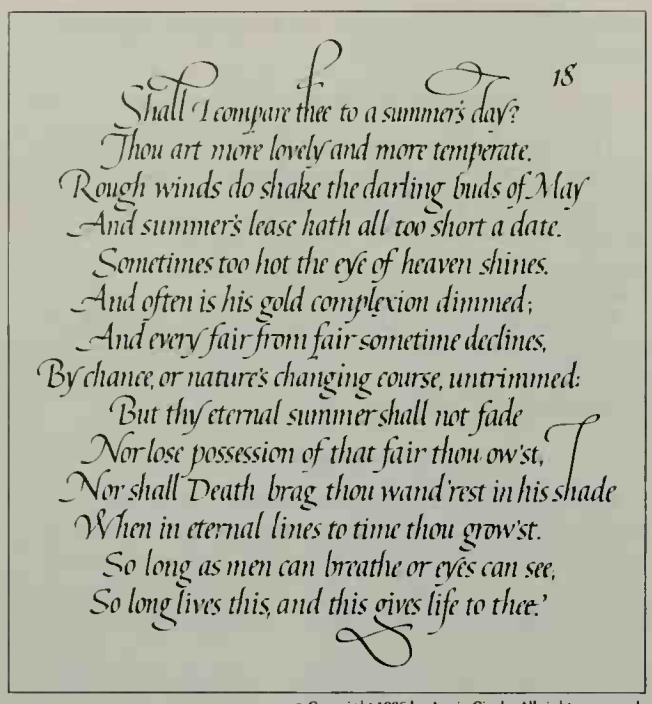
D'Nealian manuscript

From *D'Nealian™ Handwriting* by Donald Thurber. © 1981 by Scott, Foresman and Company. Reprinted by permission.



D'Nealian cursive





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Calligraphy is the art of beautiful writing. A skilled calligrapher copied this well-known sonnet by the English poet and playwright William Shakespeare.

pler and simpler. The pictures gradually became signs called *pictographs* (see **Pictograph**). Each pictograph stood for a word or an idea. This kind of picture writing probably reached its highest point about 3000 B.C. in Egypt. The Egyptians used a kind of picture writing called *hieroglyphics* (see **Hieroglyphics**). At about the same time, the Sumerians invented a system of writing that used wedge-shaped symbols called *cuneiform* (see **Cuneiform**).

About 1500 B.C., Semitic people in the Middle East invented the alphabet. In the alphabet, a written sign stands for a sound in the spoken language. For example, the letter *b* represents a certain sound. The Phoenicians developed the alphabet further. The Greeks took it over from the Phoenicians, and the Romans borrowed it from the Greeks. For more information on the history of the alphabet, see **Alphabet** and the separate articles on each letter of the alphabet.

In ancient times, few people knew how to write. Most of the people who wanted to send letters dictated them to people called *scribes,* who made their living writing for the public (see **Scribe**).

Both manuscript and cursive writing come from the Roman alphabet. In fact, we write a number of letters almost exactly as the Romans wrote them. In printing, the term *roman* refers to straight up-and-down letters similar to those used in manuscript writing. The Romans used letters like these for inscriptions on monuments and public buildings. Printers use the term *italic* for letters that slant to the right, similar to those used in cursive writing. Printing in italic letters began in Venice, Italy, during the 1500's. Several styles of cursive writing developed at this time.

Later writing styles. During the Middle Ages, monks in monasteries produced beautiful books written entirely by hand. They decorated the pages with fancy letters, borders, and pictures. Many museums treasure these books as masterpieces of writing. The monks often used a kind of writing called *Gothic* or *black-letter.* Today, people sometimes use this kind of writing on diplomas.

During the 1700's and 1800's, schoolchildren in Europe and the United States learned beautiful, but complicated, styles of cursive writing. *English Round Hand,* or *Copperplate,* became popular in the 1700's.

During the 1800's, schools in the United States taught a fancy style of writing with many loops and curves. This *Spencerian* style took its name from Platt Rogers Spencer (1800-1864), an American teacher who published many textbooks on penmanship. Children in the 1800's worked long and hard to perfect a "fine Spencerian hand" in their writing.

The 1900's. During the 1900's, schools in the United States and Great Britain began to use simpler styles of writing, particularly manuscript writing for beginners. Cursive writing was also treated less as an art and more as a practical tool. As a result, the term *penmanship* dropped out of common usage because it carried the outdated idea of writing as an exercise in beauty for its own sake. Teachers began to aim more at developing ideas in clear form. Practice methods shifted from depending heavily on separate exercises to developing good handwriting through the writing of letters and reports. Today, the purpose of learning to write is communication. Teachers help individual children check their own writing and make it more legible and fluent.

Lee M. Little Soldier

Related articles in *World Book* include:

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Cuneiform	Pictograph
Graphology	Punctuation
Hieroglyphics	Reading
Japanese language (picture)	Shorthand
	Speedwriting
Language	Spelling
Letter writing	Writing

Handwriting on the wall. According to a Bible story (Dan. 5: 1-31), the Babylonian ruler Belshazzar, during a banquet, saw the fingers of a man's hand writing the Aramaic words *mene, mene, tekel, upharsin* on his palace wall. None of Belshazzar's wise men could interpret the meaning of the words. Daniel, the Jewish prophet, said the words meant that God had weighed Belshazzar and his kingdom and had found them wanting, and would destroy them. The phrase *handwriting on the wall* now means impending disaster or misfortune. H. Darrell Lance

Handy, W. C. (1873-1958), was an American composer of blues songs. Handy did not invent the *blues,* which is a form of folk music. But he became known as the father of the blues because he brought the music to widespread public attention.

Handy wrote some of the earliest commercially successful blues songs. These songs include "St. Louis Blues" (1914), "Beale Street Blues" (1916), "Memphis Blues" (1913), and "Joe Turner Blues" (1915).

William Christopher Handy was born in Florence, Ala., and moved to Memphis, Tenn., about 1908. He

formed his own band, which toured the South for many years. In the early 1920's, Handy moved to New York City and started his own music publishing company. In 1943, he was blinded in an accident, but continued his work as a publisher, author, and concert promoter. He wrote an autobiography, *Father of the Blues* (1941), and a book on African American musicians, *Unsung Americans Sung* (1944). Richard Jackson

Courtesy of W. C. Handy, Jr.

W. C. Handy

Hang gliding. See Glider (Hang gliding).

Hanging is a legal means of execution in some states of the United States. The condemned person stands on a platform with a noose of rope around the neck. A trap door opens under the person, and the person falls until jerked to a stop by the rope. The sudden jolt breaks or dislocates the bones of the neck, causing almost immediate loss of consciousness. Death usually occurs within a few minutes. Franklin E. Zimring

See also Capital punishment (table: Capital punishment in the United States).

Hanging Gardens of Babylon. See Seven Wonders of the Ancient World.

Hangzhou, *hahng joh* (pop. 2,589,504), is a Chinese tourist center and the capital of Zhejiang Province. The city's name is also spelled *Hang-chou.* It lies on a bay about 100 miles (160 kilometers) southwest of Shanghai. For the location of Hangzhou, see **China** (political map). Hangzhou is noted for its fine silk products. Other industries in the area produce chemicals, electronic products, and iron and steel. Many tourists visit Hangzhou's famous Xi (West) Lake. Along the shore, and on four islands in the lake, are many gardens, statues, and temples.

Hangzhou began as a small fishing village. During the A.D. 500's, it became a trading center and grew rapidly. In the 1100's, the Song emperors made Hangzhou their capital. By the 1200's, Hangzhou was one of the world's largest cities. The city was badly damaged during the Taiping Rebellion (1850-1864), but was later rebuilt. The Japanese occupied Hangzhou from 1937 until the end of World War II in 1945. Most of Hangzhou's heavy industries were developed after Chinese Communists conquered the country in 1949. Parris H. Chang

Hankou. See Wuhan.

Hanks, Nancy. See Lincoln, Abraham (Early life).

Hanks, Tom (1956-), is an internationally popular motion-picture star who won fame for playing likable, charming, and innocent characters. Hanks won Academy Awards as best actor for his performances in *Philadelphia* (1993) and *Forrest Gump* (1994).

Hanks was born in Concord, California. He began his acting career in the late 1970's, appearing first on the stage, then on television and in the movies. He made his film debut in *He Knows You're Alone* (1980). His first major success was in the comic fantasy *Splash* (1984). Hanks played a young boy trapped in a grown man's body in *Big* (1988), another comic fantasy. He first gained international stardom in the 1990's. The romantic comedy *Sleepless in Seattle* (1993) was one of his most popular films.

AP/Wide World

Tom Hanks

Hanks began as a comic actor, but later expanded his career with dramatic roles in *Philadelphia, Forrest Gump, Apollo 13* (1995), and *Saving Private Ryan* (1998). His other films include *Nothing in Common* (1986), *Dragnet* (1987), *Punchline* (1988), *Turner and Hooch* (1989), *A League of Their Own* (1992), *You've Got Mail* (1998), *The Green Mile* (1999), and *Cast Away* (2000). Hanks provided the voice of Woody the toy cowboy in the popular animated feature films *Toy Story* (1995) and *Toy Story 2* (1999). Louis Giannetti

Hanna, Mark (1837-1904), an American politician and businessman, became known for managing the political campaigns of William McKinley. As chairman of the Republican National Committee in 1896, Hanna persuaded business leaders to contribute large amounts of money to McKinley's campaign that year for president of the United States. McKinley won the election.

Hanna was elected a U.S. senator from Ohio in 1897. As a senator, he helped achieve the peaceful resolution of labor disputes, especially in the coal industry. He urged business leaders to recognize and negotiate with labor unions.

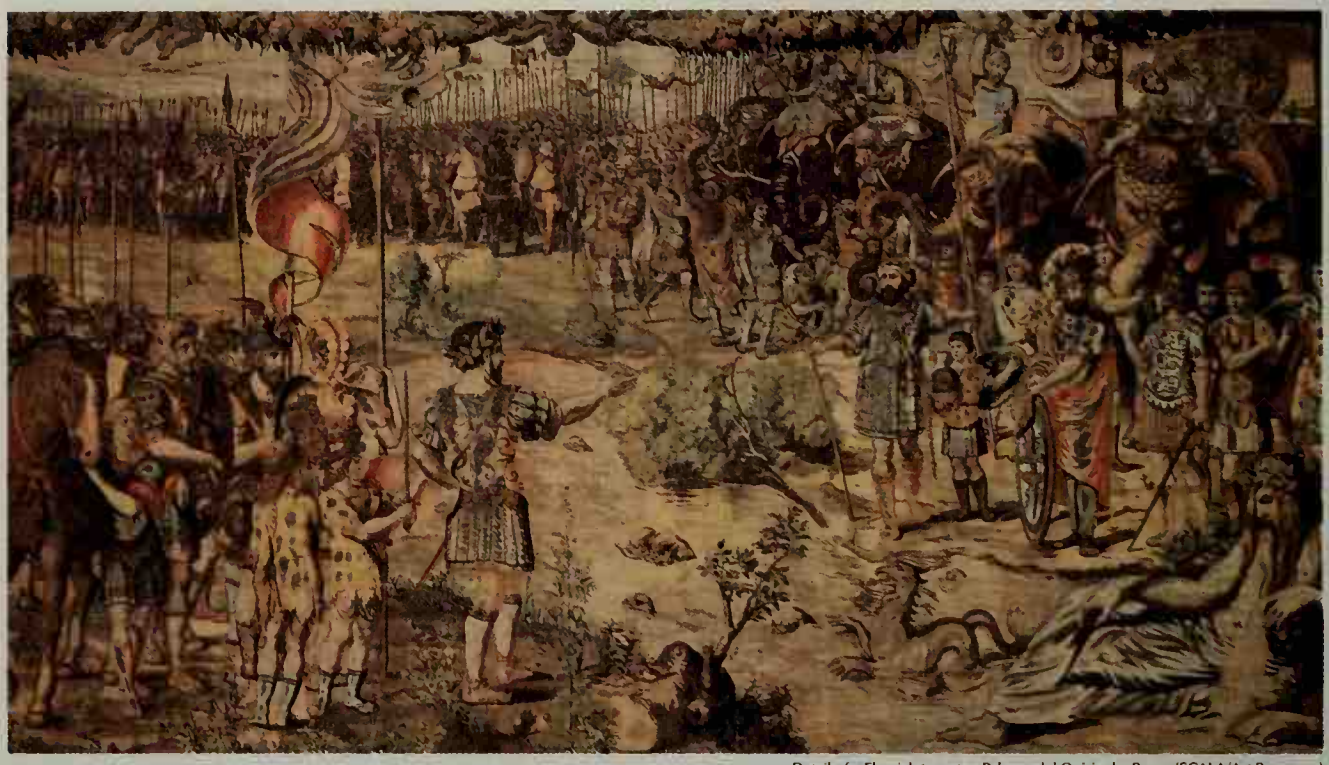
As a conservative Republican, Hanna did not support many of the progressive ideas of Theodore Roosevelt, a Republican who succeeded McKinley as president in 1901. Some conservatives promoted Hanna as a candidate for the Republican presidential nomination in 1904. But his death that year ended their efforts.

Marcus Alonzo Hanna was born in New Lisbon (now Lisbon), Ohio. He made a fortune in business before turning to politics in the 1880's. Robert W. Cherny

Hannibal (247-183 B.C.) was the greatest general and statesman of Carthage, an ancient North African city. His excellent military strategy and leadership ability helped him overcome great handicaps and defeat armies much larger than his own. Hannibal united people of varied backgrounds under his command. Even under poor conditions, Hannibal's army followed him with confidence.

His early life. Hannibal was born in Carthage. His father, Hamilcar Barca, was also a military leader. Hamilcar Barca hated the Romans, his city's chief enemy. According to tradition, Hamilcar made young Hannibal take an oath always to be an enemy of Rome. As a boy, Hannibal went with his father to Spain, a land partly ruled by Carthage. As a young man, Hannibal led troops against Spanish tribes, and helped increase Carthaginian power in Spain. Hannibal became the Carthaginian commander in Spain when he was 25 years old.

In the 220's B.C., trouble developed between Carthage and Rome over Hannibal's expansion. Hannibal attacked Saguntum, a Spanish city friendly to Rome, in 219 B.C. Rome declared war on Carthage—the Second Punic War—in 218 B.C.



Detail of a Flemish tapestry; Palazzo del Quirinale, Rome (SCALA/Art Resource)

Hannibal fought the Romans in the Second Punic War. This scene shows the Roman general Publius Cornelius Scipio, *left,* meeting Hannibal, *right,* in an effort to negotiate peace. Scipio's forces defeated Hannibal at Zama in northern Africa in 202 B.C.

His military campaigns. Early in the war, Hannibal astonished the Romans with a daring maneuver. Starting from Spain with about 60,000 troops, he crossed the Pyrenees, France, and the Alps, and entered Roman Italy. Snow and cold, and fierce mountain tribes killed many Carthaginians in the Alps. Hannibal reached the Po Valley in northern Italy with only about 26,000 troops and 6,000 horses. He also brought a few elephants because they could sometimes shatter enemy lines, like tanks in modern battles. He then recruited 15,000 to 20,000 Gauls into his army. The Gauls, also called *Celts,* lived in the Po Valley and were enemies of Rome.

A Roman army brought up from Sicily tried to stop Hannibal's advance. But Hannibal maneuvered the Romans into an ambush and defeated them in the Battle of the Trebia River. Hannibal moved on to central Italy in 217 B.C. There, he tricked a Roman army into following his army, and then destroyed the Romans in an ambush on the shores of Lake Trasimeno.

In 216 B.C., Hannibal found himself far outnumbered by the Romans at Cannae, in southern Italy. Hannibal arranged his troops in an arc. When the Romans attacked, the center of the formation retreated, and the two sides, with the help of Hannibal's superior cavalry, encircled and crushed the Romans. The Carthaginians killed about 50,000 enemy troops in one day in the worst defeat ever suffered by a Roman army.

The turning point. After Cannae, Hannibal's future looked good. But the tide soon turned against him and Carthage. Hannibal had gained allies in southern Italy, in Macedonia, and in Syracuse, Sicily. But some of his allies became too busy with their own affairs to help him. The Romans still had many loyal allies and many troops of their own in central Italy, and were able to prevent reinforcements from reaching Hannibal.

Meanwhile, the Roman general Publius Cornelius Scipio drove the Carthaginians out of Spain, and in 204 B.C. invaded Africa. Hannibal was called home to Africa in 203 B.C. His army was finally defeated by Scipio at Zama, in northern Africa, in 202 B.C. The war ended in 201 B.C. Despite Hannibal's great effort, Rome won.

After the war. Rome allowed Carthage to govern itself. Hannibal sometimes headed the government, and Carthage made a rapid recovery under his leadership. But he fled eastward in 195 B.C., after he heard the Romans were going to demand his surrender. He found protection with King Antiochus III of Syria, who was about to go to war with Rome. Antiochus made little use of Hannibal's genius and lost the war in 189 B.C. Hannibal then fled to Bithynia, a country in what is now Turkey. When the Romans demanded his surrender, Hannibal committed suicide. Arthur M. Eckstein

See also **Carthage; Hamilcar Barca; Punic Wars; Scipio Africanus, Publius Cornelius.**

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Hannibal, Missouri (pop. 17,757), is the boyhood home of the writer Mark Twain. It lies in northeast Missouri in a rich farming region along the Mississippi River (see **Missouri** [political map]). The Mark Twain Memorial Bridge across the Mississippi connects Hannibal with the state of Illinois.

Hannibal's industries include printing, tourism, woodworking, and the production of canned food products,

cement, cereals, chemicals, dairy and farm products, electrical heating elements, optical supplies, precision tools, and shoes. Chief points of interest include the Mark Twain Boyhood Home and Museum. The city is the site of Hannibal-La Grange College. Hannibal was founded in 1819. It has a city manager form of government. Jim Whitaker

See also **Twain, Mark.**

Hanoi, *hah NOY* (pop. 3,058,855), is the capital of Vietnam. The city lies in northern Vietnam on the west bank of the Red River about 55 miles (90 kilometers) from the Gulf of Tonkin. For location, see **Vietnam** (map). Second in population and economic importance to Ho Chi Minh City, Hanoi is the traditional center of administration and culture in Vietnam.

The Old Quarter, the oldest part of Hanoi, is an area of narrow streets and tiny shops near the river. The area where French colonial officials lived when the French controlled Vietnam has wide boulevards and stately villas. Ba Dinh Square in the city's center is the scene of large public ceremonies. The Ho Chi Minh Mausoleum, one of the city's most famous landmarks, stands on the square. The preserved remains of the Vietnamese Communist leader Ho Chi Minh may be seen there. Other landmarks include the One Pillar Pagoda and a complex of buildings known as the Temple of Literature. Hanoi University of Technology and the University of Hanoi are the city's largest institutions of higher learning.

Many of Hanoi's people work for the government. Hanoi's main products include building materials, chemicals, electric motors, processed foods, and textiles.

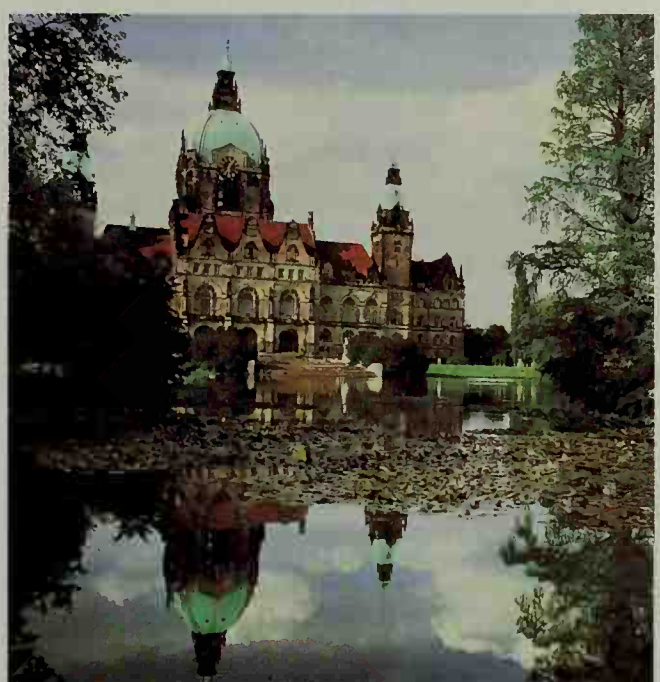
Hanoi was the capital of Vietnam and known as Thang Long during most of the period from 1010 to 1802, when Hue became the capital. Hanoi received its present name in 1831. The French took over the city in 1882 and made it the administrative center of French Indochina in 1887. Hanoi became the capital of Communist North Vietnam in 1954, when the country was divided in two after the French were defeated.

When the United States began bombing North Vietnam in the mid-1960's, during the Vietnam War, the government moved most factories out of Hanoi. The few industrial sites that remained suffered heavy damage from bombing in December 1972. The rest of the city was largely untouched. The war ended in 1975. North and South Vietnam were officially reunited in 1976 with Hanoi as the capital. Since the late 1980's, the population of Hanoi has grown rapidly. This growth has severely overtaxed the city's ability to provide water, electric power, and other basic services. William S. Turley

© Jonathan Kim, Liaison Agency

The Old Quarter of Hanoi has busy, narrow streets crowded with bicycles and other traffic. Hanoi is the capital of Vietnam and the country's traditional center of culture.

Hanover, *HAN oh vuhr* (pop. 513,010), also spelled *Hannover,* is one of Germany's largest cities (see **Germany** [political map]). It is the capital of the state of Lower Saxony. Hanover was chartered in 1241. It was the capital of the Kingdom of Hanover from 1815 to 1866.



Hubertus Kanus, Shostal

Hanover's city hall is located on beautifully landscaped grounds. Hanover lies about 60 miles (97 kilometers) southeast of Bremen. It was once the capital of the Kingdom of Hanover.

Hanover is a manufacturing center. Its products include office equipment, machinery, vehicles, tobacco products, chocolate, and cookies. The city holds an industrial fair each year. Hanover is also a railway center, and the Mittelland Canal flows through the area.

Hanover was heavily bombed during World War II (1939-1945), but it was rebuilt. It has a number of historical buildings. The buildings include Market Church, a Gothic church built in the 1300's; and the Old Town Hall, which dates from the 1400's. The city also has magnificent formal gardens called the *Herrenhausen Gardens.* The gardens date from the 1600's. Peter H. Merkl

Hanover, *HAN oh vuhr,* also spelled *Hannover,* is a historic area in northwestern Germany. In 1692, Hanover became an *electorate,* a territory whose ruler—called the *elector*—could help elect the emperor of the Holy Roman Empire. In 1714, Elector George Louis of Hanover became King George I of the United Kingdom. Hanover and the United Kingdom remained associated until 1837, when George's last male heir died. Prussia gained control of Hanover in 1866. Hanover became a province of the new German Empire in 1871. In 1946,

Hanover became part of the West German state of Lower Saxony. West Germany and East Germany united in 1990.

The Hanover region includes the cities of Göttingen, Emden, Hanover, and Oldenburg. Farming is Hanover's chief industry. But the region is also a manufacturing center. The Harz Mountains area yields timber and minerals. J. A. Hellen

Hansberry, Lorraine (1930-1965), was the first African American playwright to achieve critical and popular success on Broadway. She became famous for her first completed play, *A Raisin in the Sun* (1959), a drama about the attempt of a black family to escape from the Chicago ghetto. This play provides a study of the search for identity by African American men and women, both within the family and within a racially prejudiced American society.

Hansberry also wrote *The Sign in Sidney Brustein's Window* (1964). This drama portrays a Jewish liberal whose commitment to various social causes almost ruins his marriage. Before her death from cancer at the age of 34, Hansberry began a play about race relations in Africa. The unfinished work was published as *Les Blancs* (1970). Selections from Hansberry's letters and works were collected in *To Be Young, Gifted and Black* (1969). Hansberry was born in Chicago. Thomas P. Adler

Hanseatic League, *HAN see AT ihk,* was a loose confederation of north German cities. It grew out of trade associations that had begun to develop in the late 1100's. The weakness of the imperial power in Germany made it necessary for these cities to band together for common protection of their interests. The Hanseatic League, or *Hansa,* seems to have resulted from two earlier confederations that were grouped around the cities of Cologne and Lübeck. By the middle 1300's, the members of the Hansa included almost all the larger German towns along the North and Baltic seas.

The league had no formal constitution. Its only governing body was a congress made up of merchants from the various cities. The congress usually met at Lübeck. The main weapons of the league were commercial boycott and commercial monopoly (see **Boycott; Monopoly and competition**). If a town refused to join the league, the merchants of the town would be unable to sell their goods in profitable markets. One of the greatest contributions of the Hanseatic League was the system of maritime and commercial laws that it developed.

The Hanseatic League gained control of the fur trade with Russia, the fish trade with Norway and Sweden, and the wool trade with Flanders. In 1370, the Danish king tried to break the league's power by closing the Sound. A Hanseatic fleet seized Copenhagen and imposed severe peace terms on Denmark. After 1370, the league gradually declined in importance because of economic competition from other countries and the growing power of neighboring German states. The last meeting of the league's congress took place in 1669. Phillip N. Bebb

See also **Flag** (picture: Historical flags of the world).

Hansen's disease. See **Leprosy.**

Hanson, Howard (1896-1981), was an American composer, conductor, and educator. His works reflect the influence of the romantic movement and of such northern European composers as Jean Sibelius of Finland. Hanson's most important compositions are his orchestral works, notably his seven symphonies and five symphonic poems. Hanson won the 1944 Pulitzer Prize in music for his Symphony No. 4 (1943).

Hanson served as the director of the Eastman School of Music from 1924 to 1964. Through this position, he helped shape the musical style of several generations of American composers and musicians. Hanson also introduced the works of American composers to a large audience by conducting programs of American music throughout the United States and Europe. Hanson served as the director of the Institute of American Music at the University of Rochester from 1964 until his death. Howard Harold Hanson was born in Wahoo, Nebraska. Leonard W. Van Camp

Hanson, John (1721-1783), was a Maryland statesman at the time of the Revolutionary War in America (1775-1783). In 1781, he served as president of the Congress of the Confederation, which operated the first government of the United States.

Hanson was born in Charles County, Maryland. He served in the Maryland Assembly almost every year from 1757 to 1779. Hanson helped lead resistance to various British attempts to tax the American Colonies, including the Stamp Act of 1765 and the Townshend Acts of 1767. He also helped organize and arm troops to fight the British during the Revolutionary War.

In 1779, Hanson was elected to the Continental Congress. He signed the Articles of Confederation, the agreement by which the original 13 English colonies formed the United States in 1781. Maryland placed a statue of him in the U.S. Capitol in 1903. Pauline Maier

Hantavirus is the name of a group of viruses. Most of the hantaviruses cause *hemorrhagic fever with renal syndrome,* which is an illness that is characterized by fever, kidney failure, and internal bleeding.

In 1993, a hantavirus was identified as the cause of a deadly new disease that had broken out in the Southwestern United States. Although infection with any hantavirus is rare, 17 people became ill and 13 died in this outbreak. The disease became known as *hantavirus pulmonary syndrome.* The hantavirus that causes this disease is carried by the deer mouse, a rodent that lives in much of the United States. At first, the virus was called the Four Corners or Muerto Canyon virus. It is now named the Sin Nombre virus.

Most other hantaviruses attack the kidneys. The Sin Nombre virus, however, attacks the lungs. Early symptoms of hantavirus pulmonary syndrome resemble those of a severe cold or flu, such as fever, cough, and muscle aches. Then the lungs rapidly fill with fluid, which leads to respiratory failure and often causes death. There is no cure for hantavirus pulmonary syndrome. Doctors treat the symptoms by administering oxygen and medication. Since 1993, cases of hantavirus pulmonary syndrome have been reported throughout a large part of the United States.

Scientists think that most hantaviruses are carried by rodents and spread through rodent urine and droppings. People usually become infected by breathing dust or soil that contains tiny particles of dried droppings. A person infected with most strains of the virus does not spread the disease to other people. However,

scientists think that a hantavirus may have spread from person to person during a 1996 outbreak in Argentina.

To help prevent infection from hantaviruses, people should keep mice and rats away from areas where human beings live and work. Disinfectants should be used to clean areas where rodents may have been. When removing rodents from traps, rubber gloves should always be worn. Gustav W. Hallin

Hanukkah, *HAH nu kah,* is the Jewish Feast of Lights or Feast of Dedication. The Hebrew word *hanukkah* (also written *Hannuka* or *Chanukah*) means *dedication.* The Hanukkah holiday begins on the eve of the 25th day of the Hebrew month of Kislev (approximately December) and lasts eight days.

During Hanukkah, gifts are exchanged and contributions made to the poor. On the first evening, one candle is lighted in a special eight-branched candelabrum called a *menorah* or *hanukkiyah.* Beginning on the second night, one candle is added every night until the total reaches eight on the last night. The candles are lighted by a separate candle called a *shamash.*

The two books of Maccabees in the Apocrypha tell the story of Hanukkah (see **Bible** [Development of the Christian Old Testament]). In 165 B.C., after a three-year struggle led by Judah Maccabee, the Jews in Judea defeated the Syrian tyrant Antiochus IV. They held festivities in the Temple in Jerusalem, and dedicated it to God.

According to the Talmud, written many centuries after the event, when the Jews cleaned the Temple of Syrian idols, they found only one small cruse of oil with which to light their holy lamps. But miraculously, the cruse provided them with oil for eight days. Other sources tell of a torchlight parade in the Temple, which may also have contributed to the tradition of lighting candles on Hanukkah. B. Barry Levy

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Hanyang. See Wuhan.

Hapsburg, House of. See Habsburg, House of.

Hara-kiri, *HAR uh KIHR ee* or *HAH ruh KIHR ee,* is a method of suicide used by members of the Japanese warrior class, or *samurai.* In hara-kiri, the warrior cuts a gash in his abdomen according to a prescribed manner. An assistant then cuts off the warrior's head from behind. The Japanese term this ceremonial rite *seppuku.*

During Japan's feudal period, the samurai considered it a duty to sacrifice themselves through hara-kiri, rather than to submit to public disgrace (see **Samurai**). They performed the act as an ultimate gesture of loyalty to the lord or to a noble cause. Later, defeated commanders sometimes committed hara-kiri. Today it is generally discredited and is viewed as a feudal relic. Tetsuo Najita

Harald. See Harold I; Harold III.

Harappa. See Indus Valley civilization.

Harare, *huh RAH ray* (pop. 1,200,000), is the capital and largest city of Zimbabwe. The city serves as Zimbabwe's center of government, banking, and commerce. For location, see **Zimbabwe** (map).

Downtown, modern hotels and office buildings rise along wide, busy streets. Africa Unity Square, an open area with a beautiful park, is there. The Harare area includes an art museum, the University of Zimbabwe, and an international airport. Both upper-class suburbs and crowded slums lie on the outskirts of Harare.

Harare is a trading center for products raised on the region's fertile plains. The chief products are citrus fruits, corn, cotton, and tobacco. Industries in Harare produce clothing, fertilizer, furniture, and steel.

White South African settlers founded Harare in 1890. The town was first called Salisbury, a British name. It was governed by a British firm organized by the diamond king Cecil Rhodes. In 1923, the United Kingdom made Salisbury the capital of the self-governing colony of Southern Rhodesia. The colony became the independent nation of Zimbabwe in 1980. In 1982, Salisbury was renamed Harare, an African name. Robert I. Rotberg

See also **Zimbabwe** (picture).

Harbin, *hahr bihn* (pop. 3,597,404), is one of the large cities of China. It is the capital of Heilongjiang, the northernmost province in China's Northeast region (sometimes called Manchuria). For location, see **China** (political map).

Harbin is an important railway center. The east-west and north-south lines of the Manchurian railways intersect there. Chinese rail lines extend from Harbin to the Russian border in the northwest and east, and to Lüshun-Dalian and the Korean border in the south. Harbin's location on the Sungari River makes it a major port. The fertile soil in the area is used to grow maize, soybeans, and wheat. Harbin's chief exports are soybean products and wheat flour. Manufactured products include agricultural implements, chemicals, and leather.

Russia established Harbin in 1895 as a railroad administration center. After Japan defeated Russia in the Russo-Japanese War (1904-1905), China and Japan controlled Harbin jointly. Japan governed Harbin from 1932 until 1945, when China gained control. In the 1960's, the Chinese government, fearing an attack by the Soviet Union, built many underground factories and stores in Harbin. Harbin has many Russian-style buildings that date from the time Russia controlled the city. Parris H. Chang

Harbor is any sheltered body of water where ships may moor or anchor. Natural or landlocked harbors are found in bays and inlets where arms of land form a natural protection from waves and winds. Artificial harbors are made by erecting stone or steel *breakwaters.*

Some of the world's most beautiful harbors are at Rio de Janeiro, Brazil; Naples, Italy; and San Francisco. The world's busiest harbors include those at Kharg Island, Iran; Kobe, Japan; New York City; Ras Tanura, Saudi Arabia; and Rotterdam, the Netherlands. David S. McArthur

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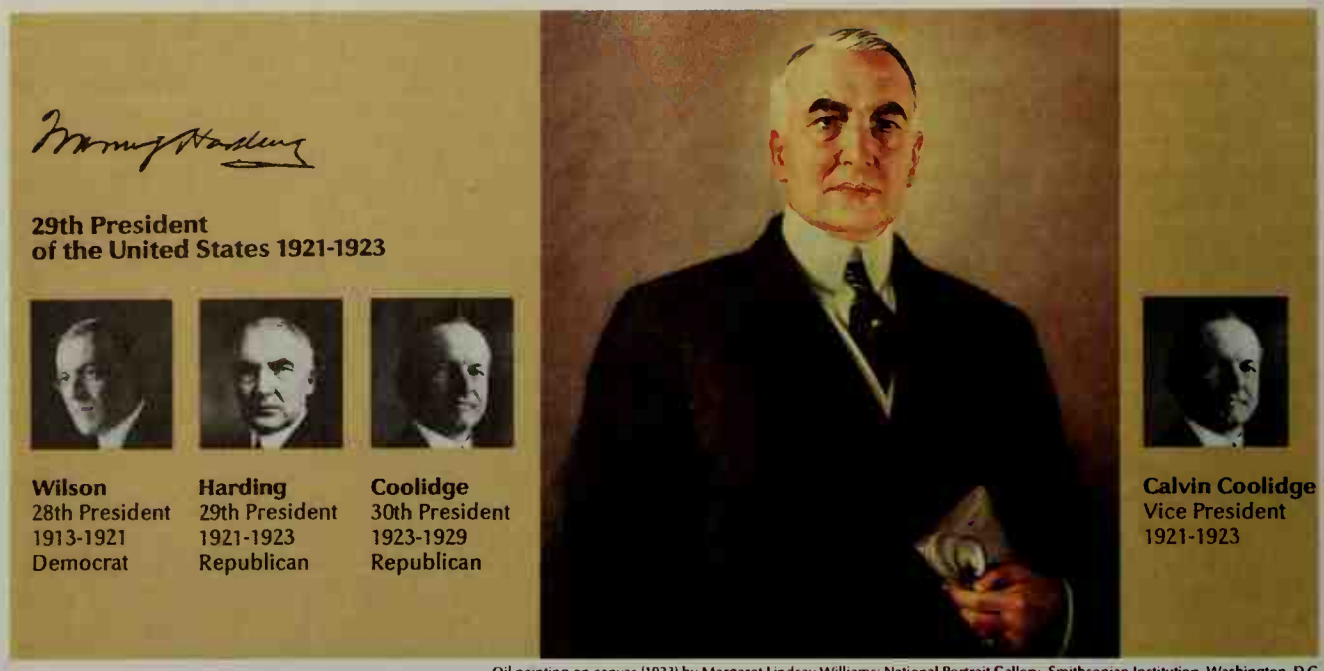
Hardening of the arteries. See Arteriosclerosis.



Oil painting on canvas (1923) by Margaret Lindsay Williams; National Portrait Gallery, Smithsonian Institution, Washington, D.C.

Harding, Warren Gamaliel (1865-1923), was elected President by a people weary of wartime restraints and world problems. His supporters expected him to turn back the clock and restore the more carefree atmosphere of pre-World War I days. Harding, an easygoing newspaper publisher and Senator, encouraged this belief by campaigning on the slogan of "Back to Normalcy." Actually, Americans would probably have elected any Republican candidate to the White House in 1920 in protest against the policies of Democratic President Woodrow Wilson. They opposed particularly Wilson's definition of American ideals, and his unwillingness to accept any changes in his plan for a League of Nations. They wished to reduce their responsibilities in world affairs and to resume their normal activities with as little bother as possible.

It was easier to praise "normalcy" than to produce it during the Roaring Twenties. The word meant so many different things to different people. Some were rebels. They danced in cabarets, drank bootleg gin, and poked fun at "normal" American life in novels and plays. Others, reacting against the rebels, wanted to standardize thought and behavior. This group persecuted radicals, tried to enforce Prohibition, and fought to ban the teaching of evolution in the public schools. With so many crosscurrents at work in American society, Harding was bound to annoy somebody as soon as he did anything.

The popularity of Harding's administration was damaged by the short but severe depression of 1921. Within two years, the Teapot Dome oil scandal and other graft in governmental agencies destroyed faith in his administration. Harding probably became aware of this widespread corruption in the summer of 1923. His anxiety about it may have hastened his death. Historians almost unanimously rank Harding as one of the weakest Presidents. But these historians have recognized that the very qualities that made him weak also made him appealing in 1920. He failed because he was weak-willed and a poor judge of character. Harding was the sixth President to die in office and was succeeded by Vice President Calvin Coolidge.

Early life

Childhood. Harding was born on Nov. 2, 1865, on a farm near Corsica (now Blooming Grove), Ohio, about 5 miles (8 kilometers) east of Galion. He was the eldest of the eight children of George Tryon Harding and Phoebe Dickerson Harding. George Harding supplemented his small income as a farmer by becoming a homeopathic doctor. He was descended from an English family that landed at Plymouth in 1624. The Hardings moved to Ohio in 1820.

Warren attended grammar schools at Corsica and Caledonia. He learned to set type on the *Caledonia Argus,* a weekly newspaper in which his father had a half ownership. Warren attended Ohio Central College, a high school in Iberia. He disliked the study of chemistry, and once put a bottle of ill-smelling hydrogen sulfide in his teacher's desk drawer. While in high school, Harding edited the school newspaper.

Newspaper career. In 1882, Harding passed an examination that allowed him to teach school. He taught for a term in a one-room schoolhouse near Marion, Ohio. Later he called teaching "the hardest job I ever had." Harding also read law and sold insurance before turning to journalism. He first worked for the *Marion Democratic Mirror.* But he was fired in 1884 for supporting James G. Blaine, the Republican candidate for President. Harding and two friends then bought the *Marion Star,* a bankrupt newspaper, for $300.

Marriage. In 1891, Harding married Florence Kling DeWolfe (Aug. 15, 1860-Nov. 21, 1924), the daughter of a prominent Marion banker. She was a divorcee, five years his senior. Florence, nicknamed "Duchess" by Harding, had a dominating personality, and great ambitions for her husband. She helped him build the *Star* into a prosperous newspaper. He became a director of several

Prohibition played an important role in American life during Harding's presidency. Government agents, such as the one shown above, destroyed huge amounts of beer and liquor.

Bettmann Archive

The world of President Harding

The Unknown Soldier of World War I was buried at Arlington National Cemetery in 1921.
Separate peace treaties with Germany, Austria, and Hungary were signed by the United States in 1921, after the U.S. Senate refused to ratify the Treaty of Versailles.
The Irish Free State became a self-governing country in 1921.
William Lyon Mackenzie King became prime minister of Canada for the first time in 1921. He held the office for a total of 21 years, longer than any other prime minister in a nation with a parliamentary government.
A naval limitation treaty was signed in 1922. The United States, Britain, Italy, France, and Japan agreed to limit the size, number, and guns of their battleships.
The Lincoln Memorial was dedicated in Washington in 1922.
The Union of Soviet Socialist Republics was established in 1922 by the Communist government.
Literature published in 1922 included *Babbitt,* Sinclair Lewis's novel about the limitations of American culture, and *The Waste Land,* T. S. Eliot's controversial poem.
A fascist party, led by Benito Mussolini, came to power in Italy in 1922.

corporations, and a trustee of the Trinity Baptist Church. The Hardings had no children.

Political and public activities

Entry into politics. Harding soon became known as both an editor and a skillful orator. He was elected Republican state senator in 1898 and lieutenant governor in 1903, but lost the 1910 election for governor.

While in state politics, Harding gained the devoted friendship of Harry M. Daugherty, a shrewd Ohio political strategist. Years later, Daugherty worked as hard to make Harding president as Mark Hanna had worked to put William McKinley in the White House in the election of 1896.

In 1912, Harding was chosen to nominate President William Howard Taft for a second term at the Republican National Convention. This honor, he said, gave him a greater thrill than his own nomination. At the 1916 national convention, Harding gave the keynote speech and also served as permanent chairman.

U.S. senator. Urged on by Daugherty and by his wife, Harding ran successfully for the United States Senate in 1914. Genial and popular, he enjoyed the good fellowship and prestige of the Senate, but introduced no major bills during his six-year term. He missed almost half of the roll calls and spent more time hunting jobs for his friends than in studying legislation. Harding usually voted with the Republican leadership. He favored high tariffs, and opposed the League of Nations and federal regulation of industry. He voted for woman suffrage, but admitted to a group of suffragists that he was "utterly indifferent" to it.

The smoke-filled room. Early in 1919, some newspapers began to mention Harding as a compromise candidate for President. Harding insisted that the Senate was "far more to my liking than the presidency possibly could be." But Daugherty, aided by Mrs. Harding, persuaded him to run for president, and became his campaign manager.

The 1920 Republican National Convention opened in Chicago on a sweltering June day. Most of the delegates supported Governor Frank O. Lowden of Illinois; Major General Leonard Wood, former Army chief of staff; or Senator Hiram W. Johnson of California. However, the ever-present Daugherty was busy behind the scenes. His welcomers greeted every delegate, urging them to support Harding as a second- or even third-choice candidate.

On the first day of voting, the convention adjourned in deadlock after four ballots. That night, a small group of powerful senators and political bosses met at the Blackstone Hotel in what Daugherty called a "smoke-filled room." At about 2 a.m., they agreed upon Harding as a compromise candidate. The delegates nominated Harding the next day and chose Governor Calvin Coolidge of Massachusetts as his running mate.

The Democrats nominated Governor James M. Cox of Ohio for president and Assistant Secretary of the Navy Franklin D. Roosevelt for vice president.

The front porch campaign. Harding conducted a front porch campaign from his home in Marion. He made speeches there and met visiting delegations. He told his secretary that handshaking "is the most pleasant thing I do." Harding avoided a clear-cut stand on the League of Nations by denouncing it but promising to work for an "association of nations." He also evaded specific domestic issues by promising "normalcy."

Harding won an overwhelming victory and became the first man to be elected to the presidency while serv-

Important dates in Harding's life

1865	(Nov. 2) Born near Corsica, Ohio.
1891	(July 8) Married Florence Kling DeWolfe.
1898	Elected to the Ohio Senate.
1903	Elected lieutenant governor of Ohio.
1914	Elected to the United States Senate.
1920	Elected president of the United States.
1923	(Aug. 2) Died in San Francisco.

Detail of an oil portrait (1921) by Philip de Laszlo; © White House Historical Association (photography by the National Geographic Society)

Florence Harding had a dominating personality and great ambitions for her husband. She helped persuade Harding to run for the Senate and then the presidency.

ing in the Senate. It was the first presidential election in which all women could vote, and in which the returns were broadcast by radio.

Harding's Administration (1921-1923)

From the beginning of his administration, Harding depended on Congress and on his Cabinet to provide leadership. He took a narrow view of his constitutional powers. Like most Republicans, he felt that during World War I President Wilson had taken powers that properly belonged to Congress.

Return to normalcy. Harding moved quickly to end the deadlock on the League of Nations. He signed peace treaties that did not include the League covenant with Germany and the other Central Powers. Congress took the leadership in domestic legislation. In 1921, it placed quotas on immigration for the first time, and reduced taxes. In 1922, it raised tariffs to record heights.

Under the leadership of Secretary of State Charles Evans Hughes, the Washington Disarmament Conference was held in 1921 and 1922 (see **Washington Conference**).

Government scandals. Harding brought so many friends to Washington that they became known as "the Ohio gang." Some were untrustworthy, but he enjoyed them socially and gave them important jobs. A tide of corruption soon began to rise. The Teapot Dome scandal was the most shocking case. It involved Secretary of the Interior Albert B. Fall, who accepted a bribe for leasing government-owned oil reserves to private companies. He was sentenced to prison in 1929 and began serving his term in 1931. See **Coolidge, Calvin** (Corruption in government); **Teapot Dome.**

Attorney General Harry M. Daugherty was tried in 1926 on charges concerning his administration of the Alien Property Custodian's Office. Two juries failed to agree on a verdict, and Daugherty was freed.

Jesse W. Smith, a friend of Daugherty, committed suicide in May 1923. It had been revealed that Smith was arranging settlements between the Department of Justice and law violators. Misuse of funds in the Veterans' Bureau resulted in the suicide of Charles F. Cramer, legal adviser of the agency, and the imprisonment of Charles R. Forbes, the director.

Death. A depression in the farm region caused the Republicans to slip badly in the 1922 Congressional elections. In June 1923, Harding sought to revive confidence in his Administration by making a speaking tour. With his wife and a large official party, he crossed the country and made the first presidential visit to Canada and Alaska. A long message in code from Washington reached Harding en route. It brought disturbing news about a Senate investigation of oil leases. Reporters later said that the depressed Harding asked them what a President could do when his friends betrayed him.

As his train passed through Seattle, Harding fell ill, presumably of food poisoning. The trip was halted in San Francisco, where doctors reported that Harding had pneumonia. After what seemed to be a short rally, the President died on August 2. No autopsy was performed, and the exact cause of Harding's death is not known.

The scandals had not yet become public, and sorrowing crowds gathered along the route as Harding's body was returned to Washington. In an effort to protect his

Harding's election

Place of nominating convention	Chicago
Ballot on which nominated	10th
Democratic opponent	James M. Cox
Electoral vote*	404 (Harding) to 127 (Cox)
Popular vote	16,133,314 (Harding) to 9,140,884 (Cox)
Age at inauguration	55

*For votes by states, see **Electoral College** (table).

Vice President and Cabinet

Vice President	Calvin Coolidge*
Secretary of state	Charles Evans Hughes*
Secretary of the treasury	Andrew W. Mellon*
Secretary of war	John W. Weeks
Attorney general	Harry M. Daugherty
Postmaster general	Will Hays Hubert Work (1922) Harry S. New (1923)
Secretary of the navy	Edwin Denby
Secretary of the interior	Albert B. Fall Hubert Work (1923)
Secretary of agriculture	Henry C. Wallace
Secretary of commerce	Herbert Hoover*
Secretary of labor	James J. Davis

*Has a separate biography in *World Book.*

Library of Congress

A stinging cartoon blamed Harding for the Teapot Dome scandal, a notorious case of corruption during his Administration. It involved accepting bribes for federal oil leases.

memory, Mrs. Harding burned as much of his correspondence as she could. She died the following year, and was buried beside Harding in Marion.

George H. Mayer

Related articles in *World Book* include:

Coolidge, Calvin
Fall, Albert B.
League of Nations
Mellon, Andrew W.
President of the United States
Roaring Twenties
Teapot Dome

Outline

I. **Early life**
   A. Childhood
   B. Newspaper career
   C. Marriage
II. **Political and public activities**
   A. Entry into politics
   B. U.S. senator
   C. The smoke-filled room
   D. The front porch campaign
III. **Harding's Administration (1921-1923)**
   A. Return to normalcy
   B. Government scandals
   C. Death

Questions

Why was Harding's election to the presidency almost certain following his nomination?
What was an important achievement of the Harding Administration in foreign affairs?
Which groups did Harding favor as President?
What was the Teapot Dome scandal?
What did Harding consider "the most pleasant thing" he did?
What member of Harding's Cabinet became President?
What was "the Ohio gang"?
What were Harding's weaknesses as President?
How did Harding avoid a positive stand on the League of Nations?
What was normalcy?

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Joseph, Paul. *Warren G. Harding.* Abdo, 1999. Younger readers.
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Hardness is the ability of a material to scratch a mark on other substances or to resist being scratched by them. Scientists measure the hardness of a material by comparing it with a table of 10 well-known minerals. The minerals are arranged in order from 1 to 10. Each mineral in the table scratches the ones with lower numbers, and can be scratched by all those with higher numbers. The standard "scale of hardness" follows:

1. Talc
2. Gypsum
3. Calcite
4. Fluorite
5. Apatite
6. Feldspar
7. Quartz
8. Topaz
9. Corundum
10. Diamond

To test another substance, you match it against the minerals of the hardness scale. You can get an approximate idea of the hardness of a mineral by using your fingernail, a copper coin, a piece of window glass, or a knife blade. The hardness of these materials is as follows: fingernail, 2 to $2\frac{1}{2}$; copper coin, $2\frac{1}{2}$ to 3; window glass, 5 to $5\frac{1}{2}$; and knife blade, $5\frac{1}{2}$.

When materials must be accurately tested, as in the manufacture of tools and gears, machinists use an instrument called a *sclerometer.* This device registers the force required to dent or scratch the material with a diamond or borazon, the hardest substances known.

David F. Hess

See also **Diamond; Borazon.**

Hardwood. See **Lumber** (Kinds of lumber); **Tree** (Broadleaf trees; Broadleaf forests; picture); **Wood.**

Hardy, Oliver. See **Laurel and Hardy.**

Hardy, Thomas (1840-1928), was an English novelist and poet. In most of Hardy's books, his characters fight a losing battle against the impersonal force of fate. Hardy summed up his vision of the unfairness of life in the novel *Tess of the d'Urbervilles.* He wrote that, with the heroine's death, "'Justice' was done, and the President of the Immortals, ... had ended his sport with Tess."

Hardy's characters can be viewed as people with psychological weaknesses. But Hardy saw human downfall not primarily as personal weakness, but rather as the result of an unwilling conflict with a hostile, meaningless universe.

Most of Hardy's stories take place in the fictional county of Wessex, a place of gloomy landscapes well suited to stories of tragedy. Hardy modeled Wessex on the county of Dorset, his birthplace.

Hardy's first successful novel, *Far from the Madding Crowd* (1874), contrasts selfish love with selfless love. *The Return of the Native* (1878) is a somber story of the tragic results of a man's illicit love for a woman. *The Mayor of Casterbridge* (1886) traces the spiritual and physical deterioration of a respected man.

Hardy's last great novels, *Tess of the d'Urbervilles* (1891) and *Jude the Obscure* (1895), treat the theme of sexual attraction with a frankness that shocked the people of his time. The public outcry against *Jude the Obscure* was so great that Hardy stopped writing novels, an occupation he had never really respected, and turned to poetry.

Hardy wrote lyric poetry of high quality. His best verse captures a profound sense of human loss and sorrow. Like his novels, many of Hardy's poems convey the bitter ironies inflicted upon humans by "Immanent Will," the blind force that he felt drives the world.

Hardy was born in Upper (or Higher) Bockhampton in Dorset. He studied architecture and worked as an architect. In the early 1870's, he abandoned architecture for a full-time career as a writer. K. K. Collins

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Hare is a long-eared mammal with powerful hind legs and a short, fluffy tail. Hares are related to rabbits and are often confused with them. But hares differ from rabbits in several ways. Hares give birth on the ground or in a scratched-out depression called a *form.* The young are born covered with fur and with their eyes open. Rabbits are born naked and blind in a fur-lined nest. Hares never dig burrows as do many rabbits. In addition, hares usually try to escape from their enemies by leaping away rapidly. Rabbits usually try to hide from enemies. The *Belgian hare* is really a type of rabbit. The *snowshoe rabbit* and the *jack rabbit* are, in fact, hares.

Most hares are brownish-gray with a pure white belly. Some kinds of hares that live in cold climates turn completely white during the winter. The largest hares grow to nearly 27 inches (69 centimeters) long and can reach a weight of more than 8 pounds (3.6 kilograms).

Hares court and mate in spring. During courtship, they often jump and twist in the air. This behavior may explain the phrase "mad as a March hare." Young hares are called *leverets.* There are usually fewer than five leverets in a litter, but there may be as many as seven litters a year.

Hares rest during the day and generally look for food during the night and at dawn. Hares eat plants and can become pests by eating and destroying alfalfa and other farm crops. Hares *thump* (tap the ground) with their hind legs, which may warn other hares of danger. Their enemies include coyotes, eagles, bobcats, and foxes.

Charles A. Long

Scientific classification. Hares are in the rabbit and hare family, Leporidae. They belong to the genus *Lepus.*

See also **Animal** (picture: Animals of the polar regions); **Jack rabbit; Rabbit; Snowshoe hare.**

Hare System. See **Proportional representation.**

Harelip. See **Cleft palate.**

Harem is the women's section of a household in some Middle Eastern and Asian countries. The word may also refer to the women who live there. The term comes from the Arabic word *haram,* meaning *forbidden.*

Traditionally, a harem was secluded and was open only to family members. The women cooked, raised children, and did other work in privacy, away from men except for their husband, sons, brothers, and fathers. Many harems housed the four wives permitted by Islam, the religion of the Muslims. A number of Turkish sultans and other wealthy rulers had large harems, which included their wives plus many mistresses, servants, and female relatives of the men. But such harems were rare because they were expensive.

Today, the practice of marrying more than one wife is forbidden by law in most nations around the world. Middle Eastern women have become less secluded. Many attend coeducational schools and work outside the home. As a result, harems have nearly disappeared, though they exist among a few ruling families.

Elizabeth Warnock Fernea

Hargreaves, James (1722?-1778), invented the spinning jenny, the first commercially successful machine to spin many threads at a time. He turned the spindles of several spinning wheels upright and placed them in a row. He then added a frame that alternately held and pulled the *rovings* (crude twists of cotton) used to make thread. Hargreaves patented the jenny in 1770, though he is thought to have invented it in 1764. John Kay's fly shuttle (also called flying shuttle) had doubled the amount of cloth weavers could produce, and the jenny supplied them with enough thread to make the cloth. The origin of the term *jenny* is unknown, but some historians think it was the name of Hargreaves's daughter.

Hargreaves was a weaver in Standhill, England, and first used the jenny at home. He then sold some machines. The sales made his patent invalid, and he was never rewarded for his invention. Local spinners worried that the increased amount of yarn the jenny spun might cost them their jobs. They burned Hargreaves's machine and drove him from the town. He moved to Nottingham in 1768 and helped found a prosperous spinning mill. His machine was used in the mill. Other manufacturers used the jenny without paying him. Hargreaves lived comfortably during the last years of his life. But he never profited from his invention as much as he might have. Richard F. Hirsh

See also **Crompton, Samuel; Spinning.**

Joe Van Wormet, Bruce Coleman Ltd

The jack rabbit is a hare, and not a true rabbit. The blacktailed jack rabbit, *shown here,* is usually found in the southwestern parts of the United States. The white-tailed jack rabbit usually lives in the northern parts of the country.

Hari-kari. See Hara-kiri.

Harkins, William Draper (1873-1951), was an American chemist who helped to clarify thinking on the nature of the atom. In 1927, Harkins described a particle of matter, now called the *neutron,* that he reasoned must exist within the atom. Harkins believed that the neutron could be formed from a positively charged proton and a negatively charged electron, which combined in a way that neutralized their charges. The English physicist James Chadwick's discovery of the neutron in 1932 confirmed this theory. Harkins was born on Dec. 28, 1873, in Titusville, Pennsylvania. Richard G. Olson

Harlan, James (1820-1899) was a United States senator from Iowa from 1855 to 1865. He first ran as a member of the Free Soil Party and later as a Republican. He became secretary of the interior in 1865 but resigned in 1866 because he opposed President Andrew Johnson's Reconstruction policies. He reentered the Senate in 1867 and voted to convict Johnson in an impeachment trial. Harlan served in the Senate until 1873. Harlan was born in Clark County, Illinois, on Aug. 26, 1820. He graduated from Indiana Asbury University (now DePauw University) in 1845. He was president of Iowa Wesleyan College from 1853 to 1855 and from 1869 to 1870. He died on Oct. 5, 1899. A statue of Harlan represents Iowa in the U.S. Capitol in Washington, D.C. James E. Sefton

Harlan, John Marshall (1833-1911), served as an associate justice of the Supreme Court of the United States from 1877 until his death. An independent, he was often the only justice to dissent from the court's majority opinions. He opposed the court's gradual narrowing of the civil rights guaranteed by the 14th Amendment. He also opposed the court's tendency to declare governmental regulation of business unconstitutional. During his term, many state legislatures tried to deal with problems created by the immense growth of industry across the United States. Harlan believed the court should respect laws enacted by these legislatures.

Harlan was born in Boyle County, Kentucky, on June 1, 1833. He attended Centre College and Transylvania University and later practiced law. Although he owned slaves, he served in the Union Army during the American Civil War (1861-1865). He served as Kentucky's attorney general from 1863 to 1867. He was the grandfather of another associate justice of the Supreme Court, also named John Marshall Harlan. The grandson served on the court from 1955 to 1971. Bruce Allen Murphy

Harlem. See New York City (Manhattan; picture).

Harlem Globetrotters. See Basketball (The history of professional basketball; picture).

Harlem Renaissance. See African Americans (The Harlem Renaissance and other achievements); American literature (The Harlem Renaissance).

Harlow, Harry Frederick (1905-1981), was an American psychologist. He provided new understanding of human behavior and development through studies of the social behavior of monkeys.

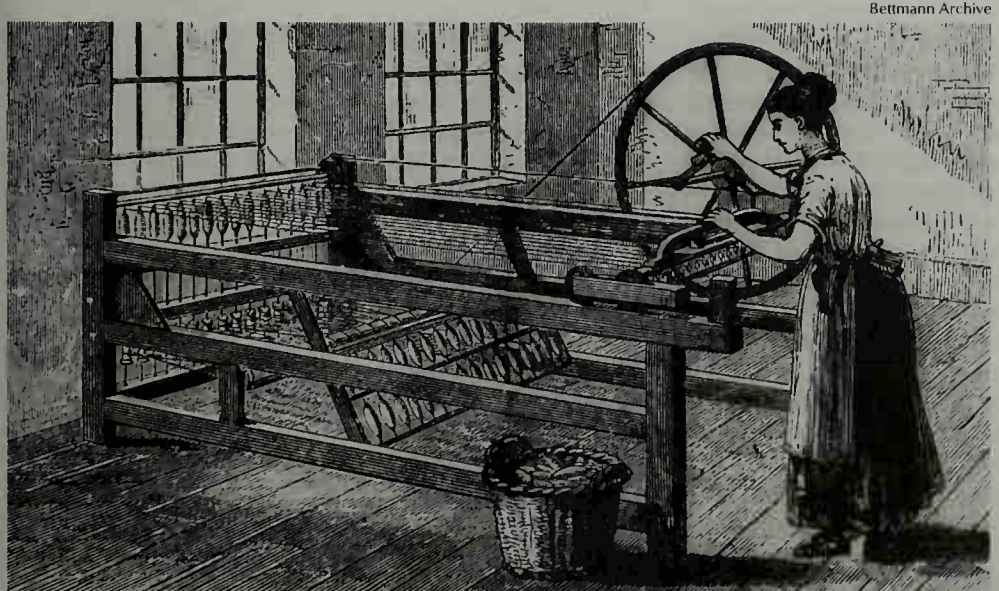
Harlow's research showed that maternal love and close social contacts are necessary at an early age for the normal development of behavior. He studied female infant monkeys that had been taken from their mothers at birth and given dummy mothers made of wire or cloth. Deprived of the care and affection of their natural mothers, the monkeys did not develop maternal instincts. Harlow also found that monkeys raised in isolation did not get along well with other monkeys.

Harlow was born in Fairfield, Iowa, on Oct. 31, 1905, and graduated from Stanford University in 1927. He received a Ph.D. degree in psychology from Stanford in 1930. He served on the faculty of the University of Wisconsin from 1930 until he retired in 1974. Harlow died on Dec. 6, 1981. John F. Henahan

Harmattan, *HAHR muh TAN,* is a cool, extremely dry wind that forms over the Sahara and blows westward or southwestward to the African coast. It blows during the dry season from December through February. The harmattan is relatively cool. It provides relief from the damp heat of the tropics. Many harmattans carry great quantities of dust from the Sahara. Richard A. Dirks

Harmonica, *hahr MAHN uh kuh,* is the name given to two simple musical instruments. The best known of these is the *mouth organ.* In this small, handheld instrument, metal reeds are inside a case. The edge of the case has separate blowholes for each reed. The instrument is played by blowing and sucking the air through these holes. The mouth organ is easy to play and is pop-

Bettmann Archive



The spinning jenny invented by James Hargreaves was operated by a large wheel. When a worker turned the wheel, spools or spindles pulled and twisted the fibers. The spinning jenny replaced the slower one-thread spinning wheel, and made it possible for spinners to keep up with the weavers' demand for yarn.

Caryle Calvin

The harmonica is a small wind instrument with reeds that produce tones when the player exhales or inhales into the holes. The 16-hole *chromatic* harmonica, *below,* has a range of four octaves.

© Pamella McReynolds

ular in the home. Such experts as Larry Adler have played the mouth organ in concerts and with orchestras.

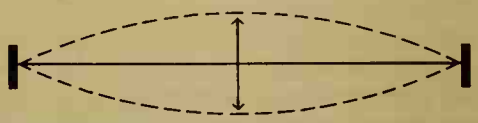
The mouth organ dates back to two instruments developed in the 1820's. The first was the *aura,* which was patented by Friedrich Buschmann of Germany in 1821. The other, called the *symphonium,* was patented by Charles Wheatstone of England in 1829.

A rarer type of harmonica is the *musical glasses,* or *glass harmonica,* invented in 1763 by Benjamin Franklin. He is said to have used the idea of Richard Pockrich, an Irishman. Franklin's instrument was a series of bowl-shaped glasses arranged by size on a spindle. The spindle was turned, and the rims of the glasses were moistened in a water-filled trough below. Music was made by holding the finger against the wet rim as the rim rotated. This instrument was fashionable in the late 1700's and early 1800's but is almost never heard today. Wolfgang Amadeus Mozart composed a quintet that includes a glass harmonica. Valerie Woodring Goertzen

Harmonics, *hahr MAHN ihks,* are the components of a musical tone. A tone is actually a blend of several separate tones. This blend, called a *composite tone,* is caused by a set of vibrations, such as those made by a musical instrument or the human voice. For example, a violin string vibrates over its entire length. But it also vibrates in segments, called *partials,* which are shorter than the total length of the string. The string vibrates in segments such as one-half, one-third, or one-fourth, of the string. Each vibrating segment produces a separate tone, called an *overtone.*

The *first harmonic,* called a *fundamental,* is the lowest tone. It results from the vibration of the whole violin string. Other harmonics, called *overtones,* come from the various vibrating segments. The *second harmonic,* also called the *first overtone,* vibrates in two segments at a frequency twice that of the fundamental, and is an octave higher. Other overtones have vibration frequencies three or more times that of the fundamental. In most cases, the higher overtones are produced with less *intensity* (loudness) than the lower ones. The fundamental and overtones combine to produce one complete tone that is the same pitch as the fundamental.

Elements of a musical tone



The fundamental is also called the *first harmonic.* It is the lowest tone produced by a vibrating violin string.

The first overtone, or *second harmonic,* vibrates in two segments at a frequency twice that of the fundamental. It is an octave higher than the fundamental.

Other overtones have vibrations three or more times that of the fundamental. The *second overtone* vibrates in three segments a fifth higher than the first overtone.

The number and intensity of a tone's harmonics determine the *timbre* (quality) of the tone. The timbre is largely responsible for the different sounds produced by various musical instruments, even when they play the same note. In the human voice, harmonics create vowel sounds and the different tone qualities that separate the sound of one voice from another. Sounds with strong high harmonics are often called *resonant* or *rich* in quality, and sounds with relatively low weak harmonics are called *soft* or *muted.* Thomas W. Tunks

See also **Sound** (Sound quality); **Tone.**

Harmonium, *hahr MOH nee uhm,* is a reed organ. Its keys control the flow of air across metal reeds. Air pressure is provided by bellows operated by the player's feet. Below the keyboard are levers that may be pressed by the knees of the player to make the tone louder or softer. Above the keyboard are "stops" by which the quality of tone may be changed. The harmonium was developed in France early in the 1800's. It is sometimes called a *parlor organ.* F. E. Kirby

Harmony, *HAHR muh nee,* is the study of musical chords and their relationships. Most chords consist of three or four notes sounding at the same time. A melody is *harmonized* when chords are added to it.

Composers used traditional harmony from about 1680 to 1900. In traditional harmony, chords are built in *thirds* (two steps apart in the scale). The bottom note is called the *root* of the chord. Chords consisting of two thirds are *triads.* Those with three thirds are *sevenths.*

One form of traditional harmony is called *functional* harmony. In functional harmony, all chords are related to one of three basic chords of a key. The main chord is the *tonic,* which is based on the first note of the scale. The others are the *dominant,* based on the fifth note, and the *subdominant,* based on the fourth note. All other chords in a key are related to one of these basic chords.

A major or minor triad is called a *consonant* chord. All other chords are called *dissonant* and, in traditional harmony, must be smoothly *resolved* (connected) to a consonant chord.

The history of harmony is the development of *chromatic* chords and *modulations.* Chromatic chords include tones outside the key. Modulation is changing from one key to another. Many composers use chromatic chords and modulations to add expression and harmonic variety to a composition.

After 1900, many composers abandoned traditional and functional harmony. Some have used streams of triads or sevenths in parallel motion. Some have built their chords out of intervals other than thirds. Many modern composers have also used triads in two or more keys sounded at the same time, or mixtures of notes sounded as chords. R. M. Longyear

See also **Rameau, Jean Philippe.**

Harmsworth, Alfred Charles William. See **Northcliffe, Viscount.**

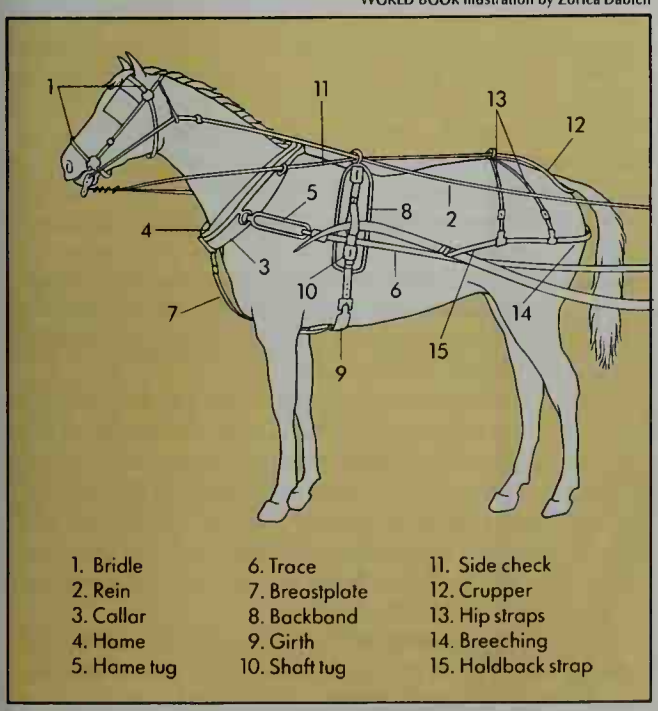
Harness is the equipment placed on a horse or other animal that enables it to pull a vehicle with its shoulders. The basic parts of a harness are the bridle, reins, collar, hames, and traces. A harness may also include other parts that are added for special situations. Most parts of a harness are made of leather and are held in place by metal buckles and clasps.

The bridle is used to control the animal's movements. It consists of straps that fit securely on the animal's head and a metal bit that fits in its mouth. The reins are attached to the bit and must be long enough to reach the vehicle's driver. The collar goes around the animal's neck at the shoulders. The hames are two curved pieces attached to each side of the collar. The traces are two long straps, ropes, or chains that connect the harness to the vehicle. One end is attached to the hames and the other is hooked to the vehicle. Sometimes an animal is harnessed between two long wooden poles called shafts that are attached to the vehicle. James H. Blackwell

Parts of the harness

All parts of the harness work together to enable the driver to control and guide the horse and to help the horse pull the load. Different types of harnesses are used for different purposes. The light harness shown below is used to pull a buggy. Horses must wear stronger harnesses when they pull heavier loads.

WORLD BOOK illustration by Zorica Dabich



1. Bridle
2. Rein
3. Collar
4. Hame
5. Hame tug
6. Trace
7. Breastplate
8. Backband
9. Girth
10. Shaft tug
11. Side check
12. Crupper
13. Hip straps
14. Breeching
15. Holdback strap

Harness racing is a popular form of horse racing. In a harness race, each horse pulls a driver in a light, two-wheeled vehicle called a *sulky.* Millions of Americans attend harness races yearly. Many races are held at major race tracks, where people can bet on the horses. Others are held at county fairs, where betting is often allowed. Harness racing is also popular in Australia, Canada, New Zealand, and most European countries.

There are two kinds of harness horses—*trotters* and *pacers.* A trotter moves the front leg on one side of its body and the hind leg on the other side at the same time. A pacer moves the legs on the same side of its body together. About 80 percent of the harness horses in the United States are pacers. In most European countries, only trotters race. The two types rarely race together because pacers generally go faster than trotters.

Harness horses are *standardbreds,* a breed that developed from thoroughbreds. The first thoroughbred to produce great trotters was Messenger. This horse was brought to the United States from England in 1788. One of Messenger's descendants, Hambletonian, is known as the "great father" of harness horses. Hambletonian was born in 1849 and sired 1,331 horses before his death in 1876. Almost all standardbreds in the United States can be traced to him. The annual Hambletonian Stakes, the most famous harness racing event, is named after him.

Drivers. In the United States, both amateur drivers and professional drivers may compete in harness races. All drivers must be licensed by their state racing commission. The United States has more than 10,000 licensed harness drivers.

The race. Harness races are held on an oval track. The track ranges from $\frac{1}{2}$ mile (0.8 kilometer) to 1 mile (1.6 kilometers) in circumference. The standard distance is 1 mile. In some races, a horse must finish first in two out of three *heats* (parts of a race) to win the race.

Before a harness race begins, the horses and drivers line up behind a specially designed automobile called a *mobile starting gate.* This vehicle has two collapsible arms that keep the horses in line. The horses follow the starting gate as it moves around the track. The gate—and the horses—gradually gain speed. The race starts one or two seconds after the gate pulls away, when the horses pass the starting line and break an electronic beam. The arms of the gate fold inward. The starting gate then speeds ahead of the horses and moves to one side of the track. The horses race around the track to the finish line. Any horse that changes from the pace or trot to another gait must be moved to the outside of the track. It must regain the correct gait before rejoining the field.

United States Trotting Association

A harness race begins after the drivers line up their horses behind a specially designed automobile called a *mobile starting gate.* The gate has two arms that keep the horses in line. After the horses reach the starting line, the arms fold up and the automobile moves off the track.

Betting. People bet on horses to finish first, second, or third in a harness race. United States tracks use the *pari-mutuel* betting system (see Horse racing [Betting]).

Regulation. The United States Trotting Association (USTA) regulates harness racing. In states where betting is legal, a state racing commission controls the races. Most commissions follow USTA rules. All drivers, harness horse owners, and most race officials must belong to the USTA.

History. Various forms of harness races have been held since ancient times. Modern harness racing developed in the United States. It probably began in the 1700's. In 1806, people in New York started to record harness racing speeds. That year, a trotter named Yankey became the first harness horse to race 1 mile in less than 3 minutes. During the 1800's, harness racing became extremely popular in the United States. Only trotters competed in races until the 1860's, when pacers were introduced. Perhaps the most popular American harness horse was Dan Patch, a pacer. In 1905, he broke a record by pacing 1 mile in 1 minute 55 $\frac{1}{4}$ seconds.

Interest in harness racing declined in the United States in the early 1900's. But the sport again grew popular in the 1940's, after pari-mutuel betting and night races were introduced. The mobile starting gate was adopted for racing in 1946.

The top harness drivers of the 1900's included Stanley F. Dancer, William R. Haughton, Delvin Miller, Joseph C. O'Brien, Herve Filion, and John D. Campbell. Filion won more races than any other harness driver. From 1961 through 1995, Filion won more than 14,000 races. Campbell ranks as the all-time leader in purses won.

In 1993, a pacer named Cambest became the fastest horse in harness-racing history by pacing a mile in 1 minute 46 $\frac{1}{5}$ seconds during a time trial. The fastest time recorded during a race is 1 minute 48 $\frac{2}{5}$ seconds by the pacer Staying Together in 1993.

Critically reviewed by the United States Trotting Association

Harnett, William Michael (1848-1892), is often called the leading American still-life painter of the late 1800's. His style of "fool-the-eye" realism was hard and precise, well suited to such subjects as groups of objects on tabletops and minutely realistic paintings of currency. Many of his paintings use objects to tell stories or symbolize moral themes.

Harnett was born on Aug. 10, 1848, in Ireland. He was brought to Philadelphia as a baby. He studied painting at the National Academy of Design in New York City. In 1873, he began painting still lifes that show the influence of the painting style of the Peale family. By 1880, he had saved enough money to travel to Europe. He spent much time in Munich, Germany, where his realistic style received much praise. Although, at the height of his career, Harnett was prevented by illness from doing much painting after 1886. His work was largely forgotten after his death but rediscovered about 1935. Sarah Burns

Harold I (860?–940?), also spelled Harald, was the first king of Norway. He formed the Kingdom of Norway about 900, after defeating a number of local rulers. He became known as Harold Fairhair (or Finehair).

Harold Halfdansson succeeded his father as ruler of Vestfold, a small kingdom in what is now southeastern Norway. Harold later extended his authority to other areas of the country, especially the southern and western coastal regions. However, he had little control over local rulers in the north and east. Harold failed to establish a line of rulers acceptable to all parts of Norway. As a result, some of his successors had to reconquer most of the country. H. Peter Krosby

Harold II (1022?-1066) was the last Saxon king of England. His defeat at the Battle of Hastings in 1066 resulted in the conquest of England by the Normans, a French-speaking people from what is now the Normandy region of France.

Harold succeeded his father, Godwin, as Earl of Wessex in 1053. This title made Harold the most powerful noble in England. He resisted Norman influence, which had become strong in England since 1042, when Edward the Confessor became England's king. In 1064, Harold was shipwrecked and fell into the hands of the Norman Duke William (later known as William the Conqueror). At this time, William may have forced Harold to swear to support his claim to the English throne.

In 1066, King Edward died. English nobles chose Harold as king, but William claimed the throne for himself. While Harold fought invading Norwegians in northern England, William invaded England in the south. After driving back the Norwegians, Harold marched his army south and was defeated and killed by William's forces at the Battle of Hastings on Oct. 14, 1066. Joel T. Rosenthal

See also **Bayeux Tapestry; Hastings, Battle of; Norman Conquest.**

Harold III (1015–1066) was king of Norway. He gained fame as a military leader and adventurer. His name is spelled Harald in Norwegian, and he became known as Harald Hårdråde, or hard ruler.

Harold Sigurdsson was the son of the king of Ringerike, a small kingdom in what is now southeastern Norway. In 1030, Harold fled Norway to escape his enemies, traveling to Sweden and Russia. In 1034, he joined the military forces of the Byzantine Empire, a powerful empire in southern and eastern Europe. With the Byzantine forces, Harold achieved great success as a commander in Sicily and the Middle East.

In 1046, Harold returned to Norway to share the rule of the country with his nephew King Magnus I. Magnus was the heir of Hardecanute (also called Hardeknud),

who had been king of both Denmark and England. Magnus died in 1047, and Harold became the sole ruler of Norway. Then Harold, as Magnus's heir, claimed the Danish throne and later the English throne. Harold fought for 17 years to gain control of Denmark, but finally acknowledged its independence in 1064. He invaded England in 1066, but was killed in the Battle of Stamford Bridge, near the city of York. Harold founded the city of Oslo about 1050. H. Peter Krosby

Harp is one of the oldest known stringed instruments. The chief instrument in the harp family is the large concert harp. Smaller harps are often used in folk music.

The modern concert harp is a large, triangular wooden instrument about 70 inches (178 centimeters) tall. The wood is often gilded and decoratively carved. The harp rests on a base called the *pedestal.* A perpendicular column called the *pillar* rises from the pedestal's front. A hollow *soundbox,* which amplifies the sound, projects at an angle from the pedestal's rear. The pillar and soundbox are joined at the top by a gracefully curved *neck.*

Forty-seven strings of varying lengths and thicknesses are stretched between the neck and the soundbox. Tuning pins in the neck set the strings to the notes of the scale over a range of 6 $\frac{1}{2}$ octaves. Seven foot-pedals extend from the pedestal. When a pedal is depressed, it raises the pitch of its corresponding strings a half- or whole-tone, depending on the distance the pedal is depressed. This mechanism, called *double action,* enables the performer to play in any key or sequence of keys. The performer sits with the harp between the knees, tilting it so it rests against the right shoulder. The player plucks the strings with the thumb and first three fingers of each hand and operates the pedals with the feet.

Early forms of the harp existed in several ancient Near Eastern civilizations. In Europe, the first harps appeared in the 700's in Ireland, where the harp is now a national symbol. Abram Loft

See also **Aeolian harp.**

Harper, Frances Ellen Watkins (1825-1911), was an American author and lecturer. She was the leading black poet of her time. Most of Harper's poems concerned antislavery and racial themes, but she also wrote about a variety of other subjects.

The Newberry Library, Chicago

Frances Harper

Frances Ellen Watkins was born of free parents in Baltimore on Sept. 24, 1825. Her parents died when she was 2 years old, and an uncle reared and educated her. She began to write poetry as a teenager and started to lecture in 1854. She spoke forcefully against slavery throughout the Northeastern United States and Canada. She married Fenton Harper, a farmer, in 1860, then gave up lecturing until after his death in 1864.

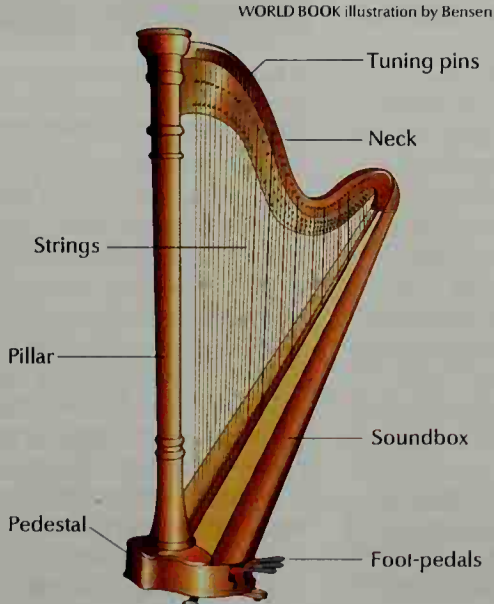
Harper often added variety to her lectures by reading some of her poems to the audience. Her books include *Poems on Miscellaneous Subjects* (1854); *Moses: A Story of the Nile* (1869); and *Iola Leroy, or Shadows Uplifted* (1892), a novel.

During her later years, Harper became known for her lectures supporting women's right to vote and opposing the use of alcoholic beverages. From 1883 to 1890, Harper served as superintendent of activities among blacks for the Woman's Christian Temperance Union (W.C.T.U.). Otey M. Scruggs

Harper, Stephen Joseph (1959-), became the leader of the Canadian Alliance, a right-of-center Canadian political party, in 2002. Harper supports limited government, national unity, free and open markets, and a strong national defense.

Harper was born on April 30, 1959, in Toronto, Ontario. He studied economics at the University of Calgary, where he earned a bachelor's degree in 1985 and a master's degree in 1991. In 1987, he helped found the conservative Reform Party of Canada. In 1992, he helped lead a successful campaign against the Charlottetown accord, a set of constitutional amendments that included recognition of Quebec as a distinct society. Harper was elected to the Canadian House of Commons in 1993 and served until 1997. From 1998 to 2001, he was president of the conservative National Citizens' Coalition.

WORLD BOOK illustration by Bensen Studios



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The harp is a large stringed instrument. The performer plays the harp sitting down, holding it between the knees. While playing, the performer tilts the harp so it rests against the right shoulder. The harp is played by plucking the strings with the fingers. The performer controls the pitch of the strings by depressing any of seven foot-pedals.

The Reform Party disbanded in 2000, and its members joined the new Canadian Alliance. The Alliance then became the official opposition in the House of Commons. Harper was elected party leader in March 2002. Later that year, he was elected to the House and became the opposition leader. David K. Stewart

Harper, William Rainey (1856-1906), an American educator, became the first president of the University of Chicago in 1891. His work as president contributed to the school's rapid growth. He selected great professors and backed them with a strong belief in academic freedom. He introduced the quarter system, the university press, and an extension division.

Harper was born on July 29, 1856, in New Concord, Ohio. He earned a Ph.D. degree at Yale University when he was 18 years old. Later, he taught Semitic languages at Yale. Glenn Smith

Harpers Ferry (pop. 307) is a village in easternmost West Virginia. It lies on the Potomac River, 55 miles (89 kilometers) northwest of Washington, D.C. (see West Virginia [political map]). At Harpers Ferry, the Potomac meets the Shenandoah River. The village was named for Robert Harper, who purchased the site in about 1747 and later operated a ferry across the Potomac.

The United States government established a federal armory and arsenal at Harpers Ferry in 1796. The town was incorporated in 1852. It became a milling, manufacturing, and transportation center. It was made famous by John Brown's raid in 1859, a critical event preceding the American Civil War (see **Brown, John**).

At the outbreak of the Civil War, a small Union garrison destroyed buildings and supplies at the arsenal and withdrew. Confederate troops under General Joseph E. Johnston occupied Harpers Ferry from April to June 1861 and then abandoned it. Union soldiers controlled the town until Sept. 15, 1862, when General Stonewall Jackson captured it during General Robert E. Lee's invasion of Maryland. After Lee's defeat at Antietam, a Union garrison again took charge. During Lee's Gettysburg campaign in July 1863, Confederate troops recaptured Harpers Ferry, but Union troops took it back. It stayed in Union hands during most of the rest of the war.

In 1867, Storer College opened at Harpers Ferry for the education of freed slaves, and it remained in operation until 1955. A national historical park was established at Harpers Ferry in 1944. Stephen W. Brown

See also **West Virginia** (Visitor's guide; picture).

Harpoon is an arrow-shaped weapon used to spear large fish and whales. A long, coiled line is tied to the harpoon. When the harpoon strikes, the weapon's barbed point becomes firmly anchored in the flesh of the target. Famous harpooners of the 1800's hurled harpoons by hand from the bow of small boats. Today, hand harpooning is still practiced by traditional Inuit hunters. In modern whaling, harpoons have been fired from powerful guns. See also **Whale** (The Basque people; Hunting techniques). William W. Robinson

Harpsichord is a musical instrument that resembles a small piano. It is used as a solo instrument, in a chamber-music ensemble, or with an orchestra.

A harpsichord is smaller and lighter than a piano and has one or two keyboards, usually called *manuals*. Like a piano, it produces sounds by causing metal strings to vibrate. But harpsichord strings are plucked, not struck like those of a piano. As a result of these differences in size and mechanical action, a harpsichord produces a tone that is clearer and livelier than that of a piano.

The strings of a harpsichord are stretched over two strips of wood called the *bridge* and the *nut*. The bridge is glued to a thin sheet of wood called the *soundboard*. The nut is glued to a block of wood that runs parallel to the keyboard and holds the tuning pins. When a string is plucked, its vibrations are transmitted by the bridge to the soundboard. The soundboard then transmits the vibrations to the sides and bottom of the instrument, called the *case*, and into the air.

A tone is produced by the plucking of the strings. Sometimes two or three strings are plucked together. Each string is plucked by a small piece of quill or leather called a *plectrum*. The plectrum sticks out from a piece of wood called a *jack*. When a player strikes a key, the jack rises and the plectrum plucks a string. When the player releases the key, the jack drops. Then, when the plectrum touches the string, it swings back on a wooden pivot called a *tongue*, and passes the string without plucking it a second time. A *damper* (felt pad) on the jack then stops the string from vibrating.

Most harpsichords have two or three strips of wood called *registers* that are used to move the sets of jacks into or out of contact with their sets of strings. Often one set of strings sounds an octave higher than the other and can be used to add brilliance to the sound.

© Pamella McReynolds

A harpsichord is a musical instrument that looks somewhat like a small piano. It has one or two keyboards, usually called *manuals*. The instrument shown here has two manuals.

The harpsichord first appeared in the 1300's, but no one knows who invented it. By the late 1500's, the instrument had become popular. During the 1600's, Italian and Flemish craftworkers built simple harpsichords to accompany solo performers. Musicians of the 1700's played richly decorated two-manual harpsichords. Famous composers of harpsichord music include Johann Sebastian Bach, François and Louis Couperin, Girolamo Frescobaldi, and Domenico Scarlatti.

By the late 1700's, the piano began to replace the harpsichord. But the harpsichord has regained its musical importance since the 1940's. Dale C. Carr

See also **Bach, Johann Sebastian; Couperin,**

François; Landowska, Wanda; Orchestra (picture: Orchestras of the 1700's); Piano (History); Scarlatti, Domenico.

Harpy, in Greek and Roman mythology, was a frightful monster that was half woman and half bird. *Harpy* comes from a Greek word meaning *to snatch.* Harpies stole food from their victims and left a dreadful smell behind them. They tormented the blind king Phineus until the sons of the north wind, who were traveling with the Argonauts, drove the Harpies away. Phineus then told the Argonauts how to pass through the Clashing Rocks (see **Argonauts**). According to Virgil, Aeneas also met the Harpies in his wanderings. Mary R. Lefkowitz

Harpy eagle is a large bird of prey that lives in lowland tropical forests. Harpy eagles live from southern Mexico to eastern Bolivia, southern Brazil, and northern Argentina. Harpies weigh over 10 pounds (4.5 kilograms) and stand 3 feet (91 centimeters) tall. Their wingspread

WORLD BOOK illustration by John F. Eggert

The harpy eagle is a South American bird of prey.

reaches 7 feet (2 meters). The harpy eagle's head and neck are gray, its chest is black, and its underparts are white. A long black crest covers the back of the head. A large black beak and massive yellow feet distinguish the bird.

This powerful eagle uses its strength to capture monkeys, sloths, opossums, and porcupines. Harpy eagles build large stick nests in tall trees. Mating pairs only breed every other year, and the female lays one or two eggs. Harpy eagles are named after the "flying monsters" in ancient Greek and Roman mythology (see **Harpy** [mythology]). Thomas G. Balgooyen

Scientific classification. The harpy eagle belongs to the family Accipitridae. Its scientific name is *Harpia harpyja.*

Harquebus, *HAHR kwuh buhs,* also called *arquebus,* was an early firearm. The weapon consisted of a short metal tube attached to a wooden *stock* (handle). A soldier loaded the weapon through the muzzle with black powder and a round bullet. A *touchhole*—a vent for carrying fire to the bullet and powder—led through the barrel to an open *pan.* The pan contained a small amount of powder. The gunner lit a slow-burning wick, called a *match,* that was held by an S-shaped device called a *serpentine.* To fire the weapon, the gunner held the stock against the shoulder, chest, or cheek and pulled a trig-

Roger Fuhr, ROLANDesign

The harquebus was an early type of firearm loaded through the muzzle. It had a matchlock firing mechanism operated by a trigger. Infantry soldiers first used harquebuses in the 1400's.

ger attached to the lower end of the serpentine. The trigger action applied the lighted match to the powder in the pan. This type of firing mechanism was known as a *matchlock.*

During the 1500's, gunsmiths developed another device, called the *wheel lock.* A *cock* held a piece of *pyrite* (a mineral containing iron) or flint against a toothed wheel. The trigger spun the wheel, and set off sparks that ignited the powder. Wheel locks were safer to use than matchlocks but were much more expensive.

The harquebus developed from the small hand cannon first used during the 1300's. The hand cannon was a heavy weapon and required supports. Foot soldiers in the 1500's preferred to use muskets. But the harquebus survived for use by mounted troops in the early 1600's. Douglas M. Wicklund

See also **Flintlock; Musket.**

Harrier is the name of 13 species of birds of prey. Harriers live everywhere in the world except polar regions, some Pacific Ocean islands, and cold, dry, treeless regions called *tundras.* The *northern harrier* is the only type that lives in North America (see **Northern harrier**).

Harriers measure from 16 to 24 inches (41 to 61 centimeters) long. The females are larger than the males. Harriers have long, narrow wings, legs, and tails. The males usually have gray feathers, and the females are brown. Most harriers have a white patch above the tail.

Harriers hunt with a flapping flight over fields, meadows, and marshes. They slowly fly close to the ground, at times briefly staying in one spot in the air. The Harrier aircraft, which can hover in the air, is named after the flight of these birds. The owllike faces of harriers reflect sound to the ears and help the birds locate prey. Harriers eat small animals, including reptiles, birds, insects, and fish.

Harriers use unusual flight patterns to court mates. These thrilling flights can include dives, tumbles, and somersaults. Harriers are usually silent, but they make sounds during courtship and when building nests. All harriers build nests on the ground except the tree-nesting *spotted harrier* of Australia. Richard D. Brown

Scientific classification. Harriers belong to the family Accipitridae.

Harrier is a breed of dog developed for the sport of hunting hares. It has a keen sense of smell and can move quickly. The harrier is sturdy and heavy-boned, with catlike feet. Most harriers have a short, white coat with black and tan patches, and floppy ears. They look like small foxhounds or large beagles. Harriers stand from 19 to 21 inches (48 to 53 centimeters) high at the shoulder and weigh 35 to 55 pounds (16 to 25 kilograms).

The breed probably originated as early as the 1000's. Its ancestry is unclear, but many breeders believe that the harrier was developed in France from a type of foxhound. Americans have raised harriers for rabbit hunt-

Walter Chandoha

The harrier has been used to hunt hares.

ing since colonial times.

Critically reviewed by the American Kennel Club

Harriman, W. Averell (1891-1986), an American statesman and businessman, was one of the leading diplomats of the mid-1900's. During World War II (1939-1945), Harriman arranged the sending of weapons and other supplies to the United Kingdom and the Soviet Union under the Lend-Lease program. He later served as United States ambassador to each of those countries.

Still later, Harriman became secretary of commerce from 1946 to 1948 under President Harry S. Truman. From 1948 to 1952, Harriman administered the European operations of the European Recovery Program, popularly known as the Marshall Plan. He served as governor of New York from 1955 to 1958. Harriman was assistant secretary of state for Far Eastern affairs from 1961 to 1963, when he became undersecretary of state for political affairs. He resigned as undersecretary in 1965 but remained in the State Department as ambassador-at-large. He was chief U.S. negotiator at the Paris peace talks on the Vietnam War in 1968 and 1969.

William Averell Harriman was born on Nov. 15, 1891, in New York City. He inherited a fortune from his father, the railroad executive E. H. Harriman. The younger Harriman served as chairman of the board of Union Pacific Railroad from 1932 to 1946. He died on July 26, 1986.

V. E. Cangelosi

Harris, Benjamin (1660?-1720), published the first newspaper in America. As a bookseller in his native London, he was punished for circulating "false" pamphlets about Roman Catholics and Quakers. He fled to America in 1686. On Sept. 25, 1690, he published *Publick Occurrences Both Forreign and Domestick* in Boston. He planned to issue his "newes-paper" at least once a month, but its scandalous stories about the French monarch antagonized colonial authorities, and no other issues were printed. See also Literature for children (The Puritans; picture). Joseph P. McKerns

Harris, Fred Roy (1930-), an Oklahoma Democrat, served in the United States Senate from 1964 to 1973. He served as chairman of the Democratic National Committee in 1969 and 1970.

Harris was born on Nov. 13, 1930, in Walters, Oklahoma. After eight years in the Oklahoma Senate, he was elected to the U.S. Senate to complete the term of the late Robert S. Kerr. He was elected to a full term in 1966. In 1967, President Lyndon B. Johnson appointed Harris to the National Advisory Commission on Civil Disorders, also known as the Kerner Commission. He was cochairman of Hubert H. Humphrey's presidential campaign in 1968. Harris ran unsuccessfully for the Democratic presidential nomination in 1972 and in 1976. David S. Broder

Harris, Joel Chandler (1848-1908), an American author and journalist, became famous for his Uncle Remus stories. Uncle Remus is a former slave who has become a beloved servant of a Southern family. He entertains the young son of the family by telling him traditional animal fables, using Southern African-American dialect of the 1800's. In these stories, animals behave and talk like human beings. Among the best-known characters of the stories are Brer (Brother) Rabbit, Brer Fox, Brer Bear, and Brer Wolf. Many literary critics and folklorists today agree that these tales contain thinly veiled racial allegories. They point out that the trickster in the stories, though the weaker figure, usually wins.

Harris was born on Dec. 9, 1848, in Eatonton, Georgia. From 1862 to 1866, he worked as a printer on a plantation near his home. The plantation owner, Joseph Addison Turner, published a newspaper called *The Countryman.* Turner introduced Harris to literature and urged him to write essays and poems. Stories that Harris heard from the plantation's slaves formed the basis of his most successful writings.

From 1876 to 1900, Harris wrote for *The Atlanta Constitution,* in which his first Uncle Remus stories appeared. He later collected the stories in book form as *Uncle Remus: His Songs and His Sayings* (1881). Readers enjoyed its humor, and critics called it an important record of manners and oral folk tales of African Americans of the southeastern United States. Harris also wrote *Nights with Uncle Remus* (1883) and *Uncle Remus and His Friends* (1892).

Harris also wrote stories and novels about Southern life during and after the American Civil War (1861-1865). Such collections as *Free Joe and Other Georgian Sketches* (1887) gave him a separate, though less celebrated, reputation from his Uncle Remus tales. Harris introduced Billy Sanders, the Sage of Shady Dale, in another collection, *On the Wing of Occasions* (1900). Through Sanders, Harris expressed the opinions of many rural Georgians. Harris died on July 3, 1908. Alan Gribben

Additional resources

Brasch, Walter M. *Brer Rabbit, Uncle Remus, and the "Cornfield Journalist": The Tale of Joel Chandler Harris.* Mercer Univ. Pr., 2000.

Harris, Joel Chandler. *Dearest Chums and Partners: Joel Chandler Harris's Letters to His Children.* Univ. of Ga. Pr., 1993.

Harris, Patricia Roberts (1924-1985), served as secretary of housing and urban development under President Jimmy Carter from 1977 to 1979. In 1979, Carter appointed her secretary of health, education, and welfare. Later that year, Congress established a separate Department of Education, and Harris's department became the Department of Health and Human Services. She headed the agency until 1981. Harris was the first African American woman to hold a Cabinet post in the United States.

Patricia Harris was born on May 31, 1924, in Mattoon,

Illinois. She graduated from Howard University and earned a law degree at George Washington University. Harris joined the faculty of the Howard University School of Law in 1961.

In 1965, President Lyndon B. Johnson appointed Harris ambassador to Luxembourg. She was the nation's first African American woman ambassador. Harris's activities in civil rights and Democratic Party politics had brought her to Johnson's attention.

U.S. Dept. of State

Patricia Harris

Harris became the dean of Howard University in 1969 but left in 1970 and joined a Washington, D.C., law firm as a partner. In 1971, International Business Machines Corporation (IBM) appointed her a director. She was the first African American woman to serve as a director of a major United States company. Harris died on March 23, 1985. Cynthia Fuchs Epstein

Harris, Robert (1849-1919), was one of the most popular and respected Canadian painters of the late 1800's and early 1900's. He became best known for his large dark-toned and richly textured portraits of influential Canadians and their families. Harris also painted landscapes, historical events, and scenes from everyday life. Harris's traditional realistic style was greatly influenced by his study of major European painters, especially the Spanish Baroque painter Diego Velázquez.

Harris was born on Sept. 18, 1849, in Conway, Wales, and immigrated to Canada with his parents in 1856. He received his first professional art training in Boston and later studied painting in London and Paris. Harris helped found the Royal Canadian Academy, an association of professional artists, in 1880 and served as the organization's president from 1893 to 1906. He died on Feb. 27, 1919. Jeremy Adamson

A Meeting of the School Trustees (1886), an oil painting on canvas; National Gallery of Canada, Ottawa

A Harris painting shows school trustees on Prince Edward Island interviewing a young teacher. The vivid, realistic character studies reflect Harris's skill as a portrait painter.

Harris, Roy (1898-1979), was an American composer. He became famous for creating and promoting a distinctly American style of classical music. Harris greatly influenced a number of other American composers, including Aaron Copland and Walter Piston.

Harris wrote 16 symphonies, 14 for orchestra and 1 each for band and for chorus. His Symphony No. 3 (1939) is one of the most frequently performed of all symphonies written by American composers. Harris often used themes from American folk music in his compositions. For example, the themes of a number of American folk songs appear in his Symphony No. 4 (1940), also known as the *Folk Song Symphony.* He based his symphonic overture *When Johnny Comes Marching Home* (1935) on the American folk song of the same name. Harris also composed music for bands and chamber groups as well as choral music and works for solo piano.

Harris was born on Feb. 12, 1898, in Lincoln County, Oklahoma. He began to study music in California. From 1926 to 1929, Harris studied in Paris under the famous music teacher Nadia Boulanger. He died on Oct. 1, 1979. Leonard W. Van Camp

Harrisburg (pop. 48,950; met. area pop. 629,401) is the capital of Pennsylvania. The city lies along the Susquehanna River, in the south-central part of the state. For location, see **Pennsylvania** (political map).

The state government is Harrisburg's largest employer. The area's manufactured products include candy and other food products and computer parts. Harrisburg has been a transportation center since the days of riverboat traffic. Today, the Pennsylvania Turnpike skirts the city, and other highways surround Harrisburg. Airlines use Harrisburg International Airport, and passenger trains and rail freight lines serve the city. A large agricultural exhibition is held in Harrisburg each January.

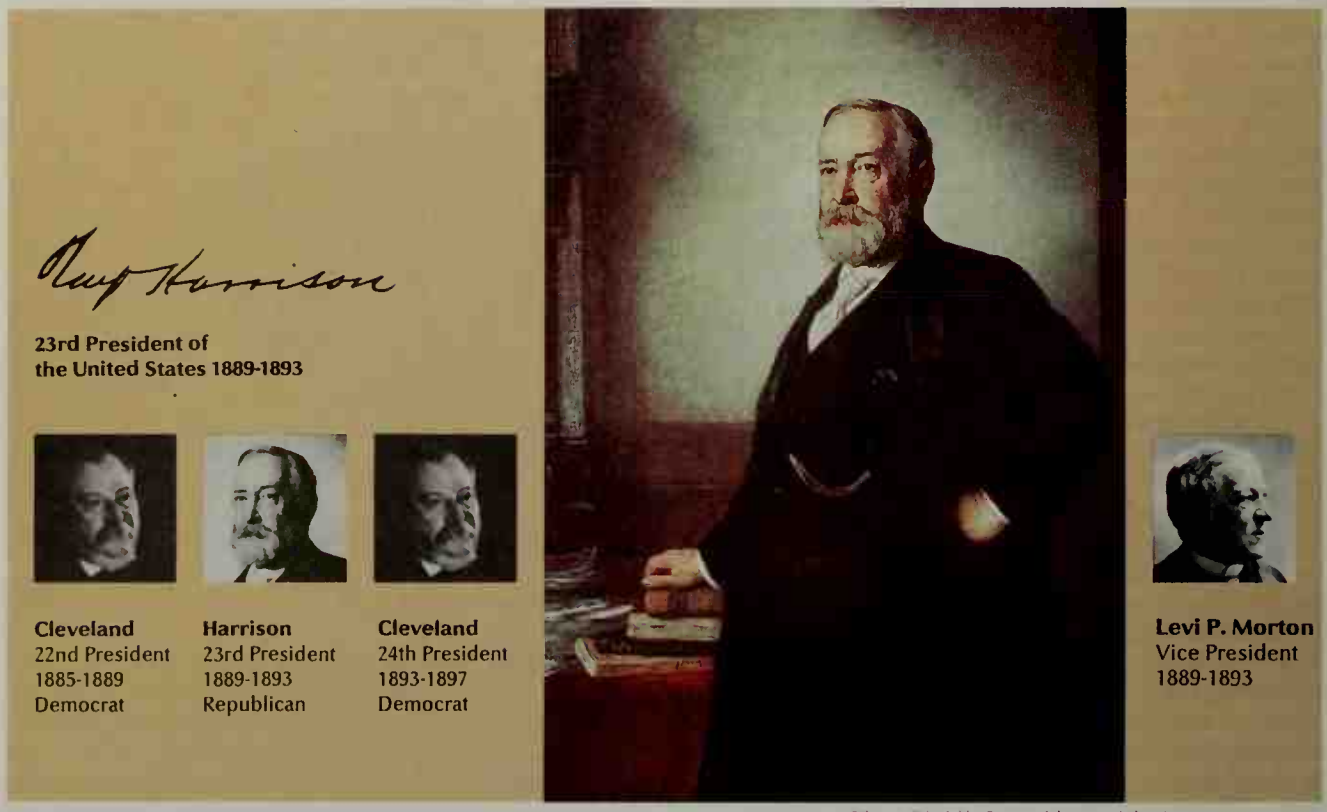
The Pennsylvania State Capitol dome rises 272 feet (83 meters) above the city. Statues by the American sculptor George Grey Barnard flank the Capitol's entrance. Harrisburg is the home of the National Civil War Museum. The city's institutions of higher education include the Dixon Center, Harrisburg Area Community College, and branches of Temple and Pennsylvania State universities.

John Harris, Sr., operated a ferry at Harrisburg in colonial days. His son John laid out the town of Harrisburg in 1785 and gave land to the Pennsylvania commonwealth that was later used for the Capitol grounds. The city became the state capital in 1812. It was a defense center during World War II (1939-1945). In 1972, Hurricane Agnes caused severe flooding in Harrisburg. In the late 1900's, revitalization efforts included new construction in the downtown area and the development of a recreation center on City Island in the Susquehanna River.

Harrisburg is the seat of Dauphin County. It has a mayor-council type of government. William C. Rense

Harrison, Benjamin (1726?-1791), was a Virginia delegate to the Continental Congress from 1774 to 1777. As chairman of the committee of the whole, Harrison presided over the debates that resulted in the Declaration of Independence. He also signed the Declaration.

Harrison was born in Charles City County, Virginia, and died on April 24, 1791. He served as governor of Virginia from 1781 to 1784. His son William Henry Harrison and his great-grandson Benjamin Harrison became presidents of the United States. Gary D. Hermalyn



Oil portrait (1895) by Eastman Johnson; © White House Historical Association (photography by the National Geographic Society)

Harrison, Benjamin (1833-1901), was the only grandson of a President who also became President. He defeated President Grover Cleveland in 1888, but Cleveland regained the presidency by beating Harrison in 1892.

Harrison's grandfather was William Henry Harrison, the hero of the Battle of Tippecanoe. Both Harrisons ran for the presidency two times, winning once and losing once. Before being elected President, both had been successful army commanders and had served in the United States Senate. Benjamin Harrison won the presidency with the help of a Republican campaign song called "Grandfather's Hat Fits Ben."

Harrison did more than any other President to increase respect for the flag of the United States. By his order, the flag waved above the White House and other government buildings. Harrison also urged that the flag be flown over every school in the land.

Congress passed the Sherman Antitrust Act during Harrison's Administration, and provided for the building of a two-ocean navy of steel ships. The American frontier disappeared as pioneers took over the last unsettled areas of the West. Six new states joined the Union. Women squeezed into whalebone corsets so they could wear the new "hourglass" fashions. James A. Naismith originated basketball, and a lively tune called "Ta-ra-ra-boom-de-ay" helped usher in the period of the Gay Nineties.

Early life

Childhood. Benjamin Harrison was born on Aug. 20, 1833, on his grandfather's farm in North Bend, Ohio. He was named for his great-grandfather, a signer of the Declaration of Independence. Ben was the second of the 10 children of John Scott Harrison and Elizabeth Irwin Harrison. His father, a farmer, served two terms in Congress. Ben, a short, stocky boy, spent his youth on the farm.

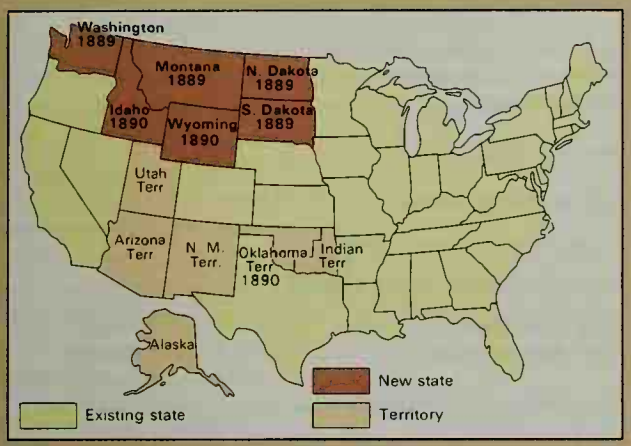
Education. Harrison attended Farmers' College in a Cincinnati suburb for three years. While a freshman, he met his future wife, Caroline Lavinia Scott (Oct. 1, 1832-Oct. 25, 1892). She was the daughter of John W. Scott, the president of a women's college in the town. In 1849, Scott moved his college to Oxford, Ohio. The next year Harrison followed the Scotts to Oxford, where he graduated from Miami University in 1852.

Harrison's family. Harrison and "Carrie" Scott were married in 1853. They had two children, Russell Benjamin (1854-1936) and Mary (1858-1930).

Lawyer. After reading law with a Cincinnati firm, Harrison was admitted to the bar in 1854. He moved to Indianapolis that same year. In his first big court case, a single candle stood on the table where Harrison had his notes. He vainly shifted the candle back and forth to get more light, but finally threw the notes away. Harrison not only discovered that he was a good speaker, but he also won the case. Harrison bolstered his income by earning $2.50 a day as court crier, proclaiming the orders of the court.

Political and public activities

Political beginnings. As the son of a Whig congressman and the grandson of a Whig President, Harrison's name was familiar to many voters. Although his father wrote him that "none but knaves should ever enter the political arena," Harrison ran successfully for city attorney of Indianapolis in 1857. He became secretary of the Republican state central committee in 1858, and was



Six states—North Dakota, South Dakota, Montana, Washington, Idaho, and Wyoming—joined the Union during Harrison's term. The Oklahoma Territory was also formed.

The United States flag had 38 stars when Harrison took office in 1889. Five stars were added to the flag in 1890. Another was added in 1891, making a total of 44 stars, *left*.

The world of President Harrison

The Eiffel Tower was dedicated in Paris in 1889.
The Johnstown flood in Pennsylvania in 1889 killed more than 2,000 people and caused over $10 million in damage.
Mark Twain's satire on the King Arthur legend, *A Connecticut Yankee in King Arthur's Court*, was published in 1889.
A land rush into what had been Indian Territory in Oklahoma opened about 2 million acres (810,000 hectares) to white settlement in 1889.
Nellie Bly, a newspaper reporter, set a record by traveling around the world in 72 days 6 hours 11 minutes, beginning in November 1889.
The first Carnegie public library in the United States was established in 1890 in Allegheny City, Pa.
The Battle of Wounded Knee took place in South Dakota in 1890. It was the last major fight on the northern plains between Indians and U.S. troops. The soldiers massacred as many as 300 Indians.
Yosemite National Park was created by Congress in 1890.
Wyoming entered the Union in 1890 as the first state with women's voting rights.
Basketball was invented in 1891 by James A. Naismith, a physical education instructor in Springfield, Mass.
Ellis Island, an island in New York Harbor, became a reception center for immigrants in 1892.
Inventions included the diesel engine, patented in 1892 by a German engineer named Rudolf Diesel, and the zipper, patented in 1893 by Whitcomb L. Judson of Chicago.

WORLD BOOK map

elected reporter of the state supreme court in 1860. He was reelected twice.

A deeply religious man, Harrison taught Sunday school. He became a deacon of the Presbyterian Church in 1857, and was elected an elder of the church in 1861.

Army commander. In 1862, Governor Oliver P. Morton asked Harrison to recruit and command the 70th Regiment of Indiana Volunteers in the Civil War. As he and Morton walked down the steps of the state Capitol, Harrison recruited his first soldier—his former law partner, William Wallace.

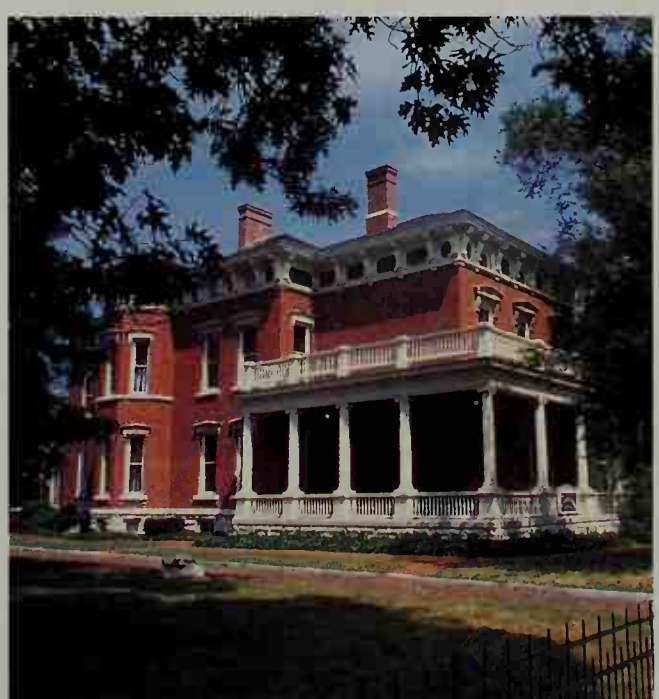
Colonel Harrison molded his regiment into a well-disciplined unit that fought in many battles. His soldiers called him "Little Ben" because he was only 5 feet 6 inches (168 centimeters) tall. A fearless commander, Harrison rose to the rank of brigadier general.

National politics. After the war, Harrison won national prestige as a lawyer. In 1876, he ran unsuccessfully for the governorship of Indiana. President Rutherford B. Hayes appointed him to the Mississippi River Commission in 1879, and he held this post until 1881. Harrison turned down a post in the Cabinet of President James A. Garfield because he had been elected to the U.S. Senate in January 1881.

During his term in the Senate, Harrison supported civil service reform, a protective tariff, a strong navy, and regulation of railroads. He criticized President Grover Cleveland's vetoes of veterans' pension bills.

Important dates in Harrison's life

1833 (Aug. 20) Born in North Bend, Ohio.
1853 (Oct. 20) Married Caroline Lavinia Scott.
1862-1864 Commanded a regiment of the Union Army.
1881 Elected to the United States Senate.
1888 Elected President of the United States.
1892 Caroline Harrison died. Defeated for reelection.
1896 (April 6) Married Mary Dimmick.
1901 (March 13) Died in Indianapolis.



President Benjamin Harrison Home

Harrison lived in Indianapolis, in this house, from 1872 until his death in 1901 except when he was in Washington. No picture of his birthplace in North Bend, Ohio, is known to exist.

Library of Congress

Caroline Scott Harrison worked hard as First Lady despite poor health. She died in 1892, two weeks before the election in which her husband lost his bid for a second term as President.

Harrison's election

Place of nominating convention	Chicago
Ballot on which nominated	8th
Democratic opponent	Grover Cleveland
Electoral vote*	233 (Harrison) to 168 (Cleveland)
Popular vote	5,534,488 (Cleveland) to 5,443,892 (Harrison)
Age at inauguration	55

*For votes by states, see Electoral College (table).

Vice President and Cabinet

Vice President	* Levi P. Morton
Secretary of state	* James G. Blaine John W. Foster (1892)
Secretary of the treasury	William Windom Charles Foster (1891)
Secretary of war	Redfield Proctor Stephen B. Elkins (1891)
Attorney general	William H. H. Miller
Postmaster general	John Wanamaker
Secretary of the Navy	Benjamin F. Tracy
Secretary of the interior	John W. Noble
Secretary of agriculture	Jeremiah M. Rusk

*Has a separate biography in *World Book*

Indiana's Democratic legislature defeated Harrison's bid for a second term by one vote.

Election of 1888. James G. Blaine, who had lost the 1884 presidential election to Cleveland, refused to run in 1888. The Republicans nominated Harrison, partly because of his war record and his popularity with veterans. Levi P. Morton, a New York City banker, was nominated for Vice President. The Democrats renominated Cleveland and named Allen G. Thurman, a former Ohio senator, as his running mate.

Harrison, in a "front porch" campaign from his home, supported high tariffs. Cleveland called for lower tariffs, but did not campaign actively because he felt it was beneath the dignity of the presidency.

In the election, Harrison trailed Cleveland by more than 90,000 popular votes. But, by carrying Indiana, New York, and several "doubtful states," Harrison won the election in the Electoral College.

Harrison's Administration (1889-1893)

The Republicans held a majority in both houses of Congress during the first half of Harrison's term. As a result, the President won enactment of his legislative program. In the congressional elections of 1890, the Democrats won control of the House of Representatives and the Republican majority in the Senate was reduced to six. The change partly reflected public disapproval of vast congressional appropriations, which reached almost a billion dollars. When Democrats accused the Republicans of wastefulness, Thomas B. Reed, Speaker of the House, replied by saying: "This is a billion-dollar country!"

Domestic affairs. During the campaign, Harrison had promised to extend the civil service law to cover more jobs. He kept his promise by increasing the number of classified positions from 27,000 to 38,000.

The four most important laws of Harrison's Administration were all passed in 1890.

The Sherman Antitrust Act. During the period of rapid industrialization in the late 1880's, many corporations formed *trusts* that controlled market prices and destroyed competition (see **Antitrust laws**). Farmers and owners of small businesses demanded government protection from these trusts. The Sherman Antitrust Act, fulfilling one of Harrison's campaign pledges, outlawed trusts or any other monopolies that hindered trade.

The Sherman Silver Purchase Act met another demand of farm voters. Farm prices were falling, and farmers asked the government to put more money into circulation, either paper money or silver coins. Farmers felt that this action would increase farm prices and thus make it easier for farmers to pay their debts. The owners of the silver mines naturally favored a demand that would boost their own profits. The Sherman Silver Purchase Act increased the amount of silver that could be coined. The government purchased this silver, and paid for it with treasury notes that could be redeemed either in silver or gold. Because most people chose to redeem their notes in gold, the fear of a resulting drain on the Treasury's gold reserves helped cause a financial panic in 1893.

The McKinley Tariff Act was designed mainly to protect U.S. industries and their workers. Its sponsors tried to make the law attractive to farmers by raising tariffs on imported farm products. But the McKinley Tariff Act set tariffs at record highs, and farmers regarded it chiefly as a benefit to business.

The Dependent Pension Bill broadened pension qualifications to include all Civil War veterans who could not perform manual labor. The cost of pensions soared from $88 million in 1889 to $159 million in 1893.

Foreign affairs. Harrison launched a program to build a two-ocean navy and expand the merchant marine. Both actions helped shape the new and vigorous foreign policy developed by Harrison and Secretary of State James G. Blaine.

Latin America. In 1889, the first Pan-American Conference met in Washington. The delegates began expanding the meaning of the Monroe Doctrine by promoting cooperation among the nations. The Pan American Union was created at this conference.

Trade with other nations was being threatened by U.S. tariffs that constantly grew higher. Harrison began to negotiate reciprocal trade agreements (see **Reciprocal trade agreement**). This was a constructive attempt to compromise between manufacturers who wanted free competitive markets and those who favored protective tariffs.

Hawaii. Early in 1893, Queen Liliuokalani had lost her throne in a revolution led by American planters. The new Hawaiian government asked the United States to make Hawaii a territory. Harrison had been defeated for reelection the previous November, but he rushed a treaty of annexation to the Senate before his term ended. Cleveland returned to the presidency before the Senate could act on the treaty, and withdrew it. He declared that the whole affair was dishonorable to the United States.

Other developments. The Harrison Administration also settled a number of old quarrels. The government agreed to arbitrate the long-standing dispute with the United Kingdom over fur seals in the Bering Sea (see **Bering Sea controversy**). In 1889, a quarrel over the ownership of the Samoa Islands seemed likely, and the United States joined Germany and the United Kingdom in establishing a protectorate over the islands. In 1892, Congress passed the Oriental Exclusion Act, which long remained a sore spot in America's relations with China and Japan (see **Oriental exclusion acts**).

Life in the White House was thoroughly photographed for the first time during Harrison's term. Electric lights and bells were installed in the mansion in 1891. But the Harrisons, fearing shocks, often used the old-style gas lights, or asked the White House electrician to turn the switches on and off.

Despite poor health, Mrs. Harrison worked hard as official hostess. She once told a reporter that "there are only five sleeping rooms and there is no feeling of privacy." Members of the Harrison family usually occupied these rooms. Mrs. Harrison's father lived in the White House, as did Mrs. Mary Dimmick, a widowed niece who served as her secretary. The Harrisons' daughter, Mrs. Mary McKee, and her husband and two children lived there most of the time.

Bid for reelection. The Republicans renominated Harrison in 1892, and chose Whitelaw Reid, editor of the *New York Tribune,* as his running mate. The Democrats again nominated Cleveland for president, and named Adlai E. Stevenson, a former Illinois congressman, for vice president.

Discontented farmers turned from the Republicans to the new Populist Party, which had been formed in protest against falling farm prices (see **Populism**). Angry factory workers deserted the Republicans, charging hostile interference by the federal and state governments in the bloody Homestead Strike and other labor disputes (see **Homestead Strike**). Opposition to the McKinley Tariff Act also helped defeat Harrison, who received 5,182,690 popular votes to Cleveland's 5,555,426. The Populist candidate, James B. Weaver, received more than a million votes. This gave Cleveland 277 electoral votes to Harrison's 145. Weaver received 22 electoral votes.

Personal tragedy struck Harrison just two weeks before the national elections of 1892. His wife died on October 25.

Later years

Harrison returned to Indianapolis and the practice of law. In 1896, he married Mrs. Dimmick (April 30, 1858-Jan. 5, 1948), who had nursed his wife during her last illness. They had one child, Elizabeth (1897-1955).

In 1897, Harrison wrote *This Country of Ours,* a book about the federal government. In 1899, he represented Venezuela in the arbitration of a dispute with the United Kingdom over the British Guiana boundary. Harrison died in his home on March 13, 1901, and was buried in Indianapolis. H. Wayne Morgan

Related articles in *World Book* include:

Cleveland, Grover
McKinley, William
Morton, Levi P.
Pan-American Conferences
President of the United States
Tariff

Outline

I. Early life
- A. Childhood
- B. Education
- C. Harrison's family
- D. Lawyer

II. Political and public activities
- A. Political beginnings
- B. Army commander
- C. National politics
- D. Election of 1888

III. Harrison's administration (1889-1893)
- A. Domestic affairs
- B. Foreign affairs
- C. Life in the White House
- D. Bid for reelection

IV. Later years

Questions

Who was the only man whose father and son both became president?
What was unusual about the results of the 1888 presidential election?
How did Harrison please Civil War veterans?
Why did he decline a post in Garfield's Cabinet?
What reforms did farmers and persons who owned small businesses seek? Why?
How did the United States show its interest in Latin America during Harrison's administration?
What factors led to Harrison's defeat in 1892?
How was the White House modernized during Harrison's administration?

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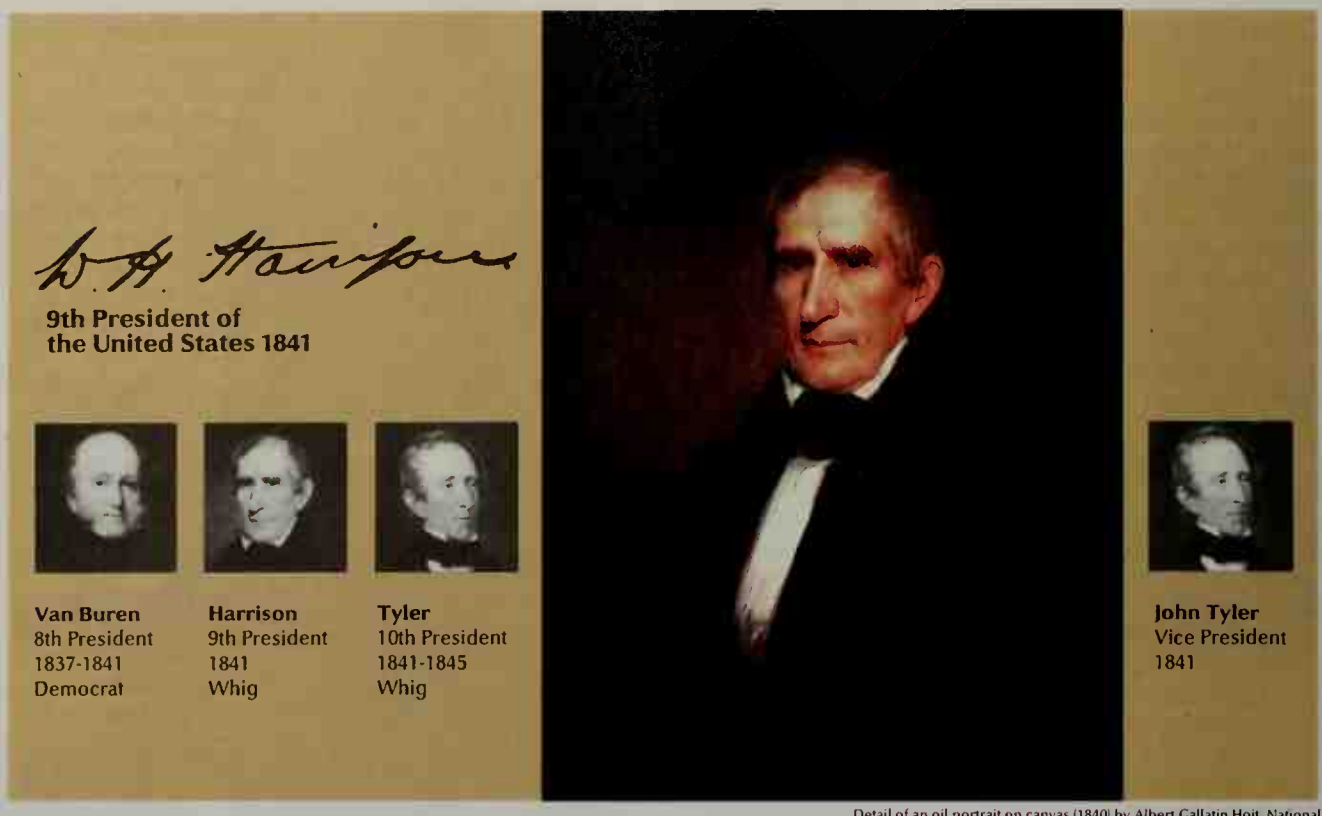
Harrison, George. See Beatles.



Detail of an oil portrait on canvas (1840) by Albert Gallatin Hoit, National Portrait Gallery, Smithsonian Institution, Washington, D.C.

Harrison, William Henry (1773-1841), served the shortest time in office of any President in American history. He caught cold the day he was inaugurated President, and he died 30 days later. Harrison was the first President to die in office.

Harrison is best remembered as the first half of the catchy political campaign slogan "Tippecanoe and Tyler too." He had received the nickname "Tippecanoe" after defeating the Shawnee Indians in 1811 at the Battle of Tippecanoe. The Whig Party first ran Harrison for President against Democrat Martin Van Buren in 1836. He lost. Then they ran him again in 1840. Using his colorful military career as their theme, the Whigs turned the campaign of 1840 into a circus. This time, Harrison defeated President Van Buren. Harrison was the first Whig President, and the only chief executive whose grandson (Benjamin Harrison) also became President.

During his brief term, Harrison showed an interest in running the government efficiently. He made surprise visits to government offices to check on the workers. Upon Harrison's death, his office fell to Vice President John Tyler, a former Virginia Democrat. The Whigs had nominated Tyler to attract Southern votes. But when Tyler became President, the Whigs unhappily learned that he still believed in many of the ideas of the Democratic party. He vetoed bill after bill, and destroyed the Whig program in Congress.

Early life

William Henry Harrison was born on Feb. 9, 1773, at Berkeley, his father's plantation in Charles City County, Virginia. He was the youngest of seven children, four girls and three boys. His parents, Benjamin and Elizabeth Bassett Harrison, came from prominent Virginia families. The elder Harrison had served in both Continental Congresses, and signed the Declaration of Independence.

William received his early education at home. He entered Hampden-Sydney College in 1787 and later enrolled at the University of Pennsylvania to study medicine. After his father died in 1791, Harrison dropped medicine and joined the Army. George Washington, a friend of his father, approved this decision.

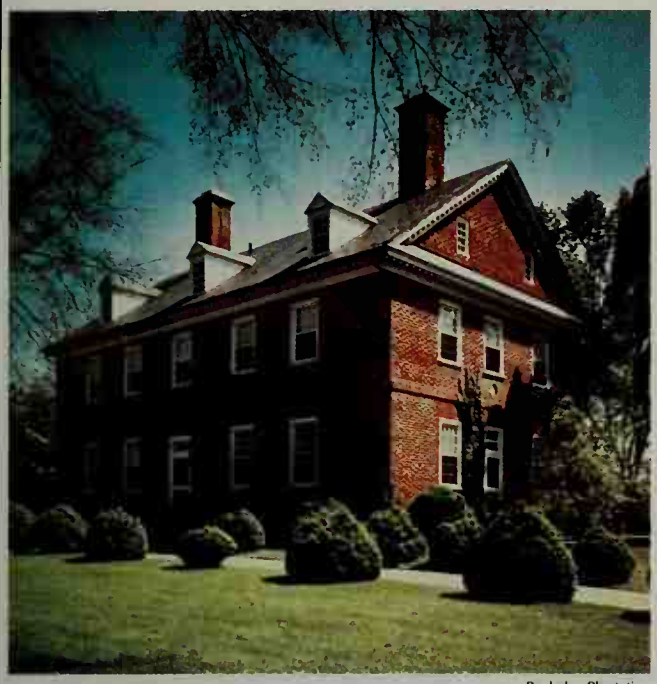
Military and political career

Soldier. Harrison served in early American wars against the Indians, and rose to the rank of lieutenant. In 1794, he developed a plan which led to an American victory on the Great Miami River. He was promoted to captain and given command of Fort Washington, Ohio.

Harrison's family. While at Fort Washington, Harrison met and married Anna Symmes (July 25, 1775-Feb. 25, 1864). She was the daughter of John C. Symmes, a judge and wealthy land investor. The Harrisons had six sons and four daughters. Six of the children died before Harrison became President.

Entry into politics. Harrison resigned his Army commission in June 1798, and President John Adams appointed him secretary of the Northwest Territory. In 1799, Harrison was elected the first delegate to Congress from the Northwest Territory. In Congress, Harrison convinced the lawmakers to pass a bill that divided western lands into sections small enough for even a poor person to buy.

In 1800, Adams named Harrison governor of the Indiana Territory, a post he held for 12 years. As governor, Harrison sought to protect the welfare of American Indians living in the territory. He banned the sale of liquor to



Berkeley Plantation

Harrison's birthplace, Berkeley, was his father's plantation in Charles City County. It stands on the James River, about 20 miles (32 kilometers) from Richmond, Va.

them, and ordered that they be inoculated against smallpox. In 1809, Harrison negotiated a treaty with Indian leaders which transferred about 2,900,000 acres (1,170,000 hectares) of land on the Wabash and White rivers to settlers. Many Indians denounced the treaty. They united under the Shawnee chief Tecumseh and his brother, known as the Shawnee Prophet. Harrison took command of the territorial militia and set out to drive the Indians from treaty lands. On Nov. 7, 1811, Harrison's outnumbered troops shattered the Indian forces in the Battle of Tippecanoe.

Army commander. When the War of 1812 began, President James Madison made Harrison a brigadier general in command of the Army of the Northwest. Harrison was promoted to major general early in 1813. In October 1813, his troops won a brilliant victory over combined Indian and British forces in the Battle of the Thames in southern Ontario.

Return to politics. Harrison again resigned from the army in 1814 after a quarrel with the secretary of war. He settled on a farm in North Bend, Ohio. In 1816, he was elected to the United States House of Representatives. He was accused of misusing public money while in the Army, but a House investigating committee held the charge false. His name cleared, Harrison returned to Ohio. In 1819, he was elected a state senator. The legislature elected him to the United States Senate in 1825. He resigned in 1828 to accept an appointment from President John Quincy Adams as the U.S. minister to Colombia. But the blunt-spoken Harrison lasted about a year in diplomacy. President Andrew Jackson appointed one of his supporters to replace Harrison in 1829.

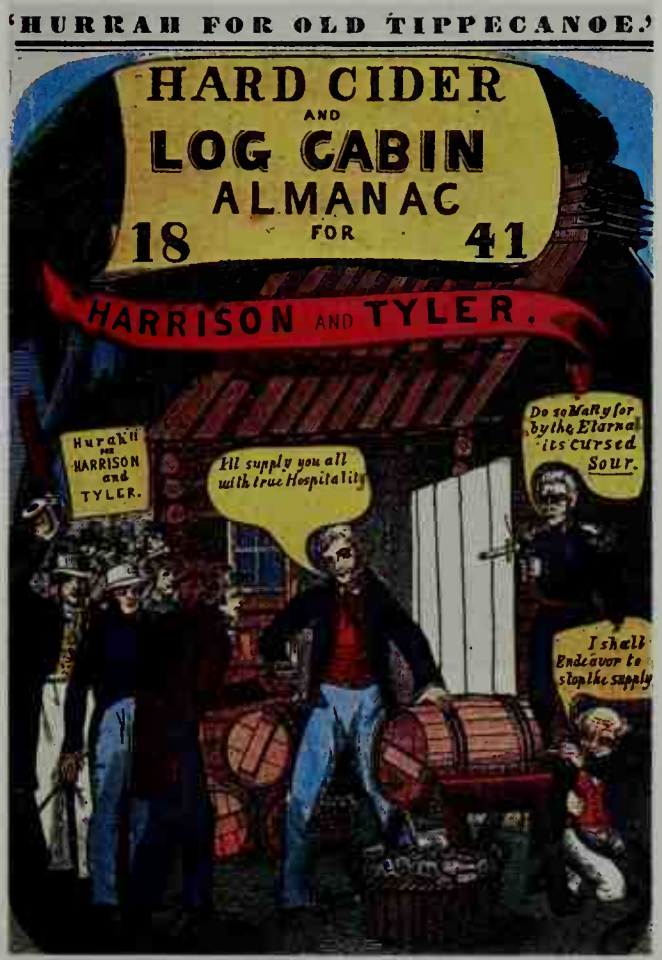
Elections of 1836 and 1840. Harrison was one of three Whig Party candidates for the presidency in 1836. The party was a mixture of people with conflicting ideas of government, and Harrison's supporters felt he could unify the party. He ran surprisingly well, winning 73 electoral votes. Democrat Martin Van Buren won the presidency with 170 electoral votes.

In 1840, the still-divided Whigs tried to broaden their appeal, which had been confined mainly to big eastern cities. They nominated Harrison again and, for Vice President, chose John Tyler, a Virginia Democrat.

The Whigs made no attempt to agree on issues or even to adopt a platform. They simply hoped to hang together until they won the presidency. They did this by emphasizing antics rather than issues. Party leaders told Harrison to say "not one single word about his principles or creed." A Democratic newspaper charged that all Harrison wanted for the rest of his life was a pension, a log cabin, and plenty of hard cider. The Whigs turned this sneer to their advantage by proudly presenting Har-

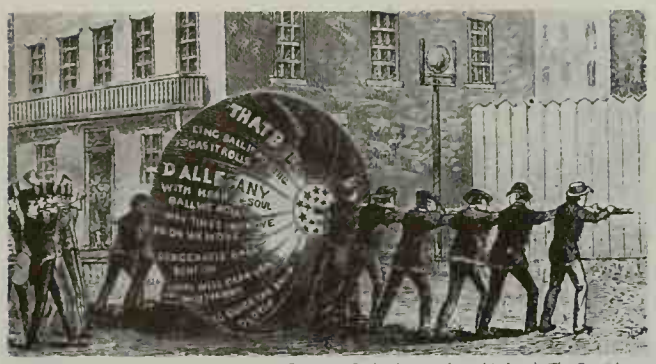
Important dates in Harrison's life

1773	(Feb. 9) Born in Charles City County, Virginia.
1795	(Nov. 25) Married Anna Symmes.
1800	Appointed governor of Indiana Territory.
1811	Defeated Indians in the Battle of Tippecanoe.
1812-1814	Served in the War of 1812.
1816	Elected to the U.S. House of Representatives.
1825	Elected to the United States Senate.
1828	Appointed U.S. Minister to Colombia.
1836	Defeated for presidency by Martin Van Buren.
1840	Elected President of the United States.
1841	(April 4) Died in the White House.



Granger Collection

The 1840 campaign focused on slogans rather than issues. The cartoon, *above,* showed Harrison as a simple frontiersman, even though he came from a prominent Virginia family.



Courtesy Stefan Lorant, from his book *The Presidency*

The campaign of 1840 emphasized antics instead of issues. Harrison's supporters held parades like the one shown above, which featured a giant paper ball covered with election slogans.

Harrison's election

Place of nominating convention	Baltimore
Ballot on which nominated	2nd
Democratic opponent	Martin Van Buren
Electoral vote*	234 (Harrison) to 60 (Van Buren)
Popular vote	1,275,390 (Harrison) to 1,128,854 (Van Buren)
Age at inauguration	68

*For votes by states, see Electoral College (table).

President Benjamin Harrison Home, Indianapolis (detail)

Anna Symmes, *above,* married William Henry Harrison in 1795. She became too ill to travel just before her husband left for Washington to become President in 1841. Jane Irwin Harrison, *right*—the couple's widowed daughter-in-law—served as White House hostess during Harrison's brief presidency.

Daughters of the American Revolution, Francis Vigo Chapter, Vincennes, Indiana
White House Historical Association

Vice President and Cabinet

Vice President	* John Tyler
Secretary of state	* Daniel Webster
Secretary of the treasury	Thomas Ewing
Secretary of war	* John Bell
Attorney general	John J. Crittenden
Postmaster general	Francis Granger
Secretary of the Navy	George E. Badger

*Has a separate biography in World Book.

rison as "the log cabin, hard cider" candidate. Torchlight parades with cider barrels and log cabins on wagons rolled down streets all over the nation. The Whigs blamed President Van Buren, the Democratic candidate, for the country's hard times. They contrasted the hungry workers with the aristocratic Van Buren, who they said wore "corsets and silk stockings." Harrison won by about 147,000 votes but had a huge electoral majority.

Harrison's Administration (1841)

Harrison's wife became too ill to travel just before he left for Washington, so he was accompanied by his widowed daughter-in-law, Jane Irwin Harrison. She served as White House hostess during his term. It was a cold, rainy day when Harrison gave his inaugural address. He caught a cold, which a month later proved fatal.

Harrison spent his energy deciding political appointments. He left the development of a legislative program to Henry Clay, the Whig leader in Congress.

The *Caroline* affair. Just one week after Harrison took office, the United States faced a serious crisis with Britain. Over three years earlier, a member of the American crew of the steamboat *Caroline* had been killed while carrying supplies to Canadian rebels. Much later, police in Buffalo, New York, arrested a visiting Canadian who had been one of the party that attacked the *Caroline*. The British waited until Van Buren had left office, then demanded the prisoner's release on threat of war. Harrison turned the problem over to Daniel Webster, who apologized. But tension was not eased until Webster negotiated the Webster-Ashburton Treaty in 1842 (see **Webster-Ashburton Treaty**).

Death. Harrison sought relief from the pressures of his office by attending to minor details of running the White House. One raw March morning, he went out to buy vegetables and suffered a severe chill. The cold he had caught on inauguration day now developed into pneumonia. Harrison died on April 4, 1841, 12 $\frac{1}{2}$ hours short of 31 full days in office. He was buried in North Bend, Ohio. Steven Mintz

Related articles in *World Book* include:

Indian wars (Other Midwestern conflicts)	Tyler, John
President of the United States	Van Buren, Martin
Tecumseh	War of 1812
	Whig Party

Outline

I. **Early life**
II. **Military and political career**
  A. Soldier
  B. Harrison's family
  C. Entry into politics
  D. Army commander
  E. Return to politics
  F. Elections of 1836 and 1840
III. **Harrison's Administration (1841)**
  A. The *Caroline* affair
  B. Death

Questions

What "firsts" mark Harrison's presidency?

What causes led to Harrison's death?
Why was "Tippecanoe and Tyler too" a good slogan?
Why did the Whigs nominate Tyler for vice president?
How did the Whigs develop the idea of their "log cabin, hard cider" campaign in 1840?

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Harrow, *HAR oh,* is an implement that farmers use to break plowed earth into smaller pieces before they plant seeds. The clods of earth left by the plow are too large for the delicate shoots to break through and too rough for machines to travel over during cultivation and harvesting. The harrow is also used to kill weeds and cover newly sown seeds. There are three main types: (1) the disk harrow, (2) the spike-tooth harrow, and (3) the spring-tooth harrow.

The *disk harrow* is a set of sharp disks, from 16 to 28 inches (41 to 71 centimeters) in diameter, mounted on a shaft. Such a unit is called a *gang.* Disk harrows commonly have one or two pairs of gangs. Each pair ranges from 5 to 50 feet (1.5 to 15 meters) wide. As the harrow is pulled forward, the disks revolve and cut the soil. If the soil is not hard, a disk harrow can be used as both harrow and plow. Such harrows can be weighted to make the disks cut more deeply. Disk harrows require more pulling power than do other types of harrows. They did not come into wide use until farmers began using tractors instead of farm animals to pull them.

The *spike-tooth harrow* is a set of two to six steel frames. Each frame can work an area about 5 feet (1.5 meters) square and has rods running across it. Steel teeth on the rods "comb" the soil as the harrow is pulled. This harrow works best on well-cleared land.

The *spring-tooth harrow* consists of a steel frame that may be from 5 to 40 feet (1.5 to 12 meters) wide or wider. Steel teeth shaped in a half circle are bolted into the frame. With a springing action, the teeth tear into the soil when the harrow moves. These harrows are well-suited for rough, rocky ground. R. Douglas Hurt

Harrow School, *HAR oh,* is a leading public school in England. It was founded in 1572 by John Lyon, a wealthy landowner. Harrow School was at first intended to educate the poor boys of Harrow parish, which is about 12 miles (19 kilometers) from London. Most of its pupils are now admitted on payment of fees. Harrow taught only classical subjects until the 1800's. P. A. McGinley

Harsha, *HUHR shuh* (A.D. 590?-647), an Indian emperor, ruled most of northern India from A.D. 606 to 647. Harsha, also known as Harsha-vardhana, inherited a small kingdom in the Ganges River Valley at age 16 and then conquered most neighboring kingdoms. He reestablished a unified empire in India after the decline of the Gupta dynasty, invasions of the Huns from central Asia, and decades of regional political revolts. He supported Hindu and Buddhist religious institutions, philosophy, and literature. He is credited with writing three well-known plays—*Nagananda, Ratnavali,* and *Priyadarsika.* After Harsha died, his empire soon broke up.

Michael H. Fisher

Hart, John (1711?-1779), was a signer of the Declaration of Independence. He was a prosperous farmer and served in the colonial New Jersey Assembly from 1761 to 1771 and as speaker of the state's General Assembly in 1776. Hart was an early supporter of the American cause and opposed the Stamp Act (see **Stamp Act**). He was born in Stonington, Connecticut. Jack N. Rakove

Hart, Lorenz (1895-1943), was an American writer of lyrics of popular songs. He became famous for the songs that he and the composer Richard Rodgers created for many musical comedies. Rodgers and Hart were the first team in which the lyricist received equal billing with the composer.

Hart was born in New York City. He and Rodgers began to work together in 1919 and achieved their first success with *The Garrick Gaities* (1925). The team produced its best work during the late 1920's and the 1930's. During that period, only Cole Porter rivaled Hart for satirical wit and freshness of rhymes. Hart's best-known songs include "Falling in Love with Love," "My Funny Valentine," "Thou Swell," "Where or When," "Bewitched, Bothered and Bewildered," and "Manhattan." These songs appeared in such musicals as *A Connecticut Yankee* (1927), *Babes in Arms* (1937), *The Boys from Syracuse* (1938), and *Pal Joey* (1940).

Hart and Rodgers moved to Hollywood in 1930 to compose for motion pictures. They returned to New York City in 1934 and resumed writing for the stage.

Ken Bloom

See also **Rodgers, Richard.**

Hart, Moss (1904-1961), was an American playwright and director. He became famous for a series of witty comedies on American life that he wrote with George S. Kaufman. Their first success was *Once in a Lifetime* (1930), a satire about the motion-picture industry. Hart and Kaufman won the 1937 Pulitzer Prize for drama for *You Can't Take It with You,* a comedy about a family of lovable eccentrics. Their other works included *Merrily We Roll Along* (1934), *The Man Who Came to Dinner* (1939), and *George Washington Slept Here* (1940).

Hart wrote several plays by himself, including *Winged Victory* (1943), *Light Up the Sky* (1948), and *The Climate of Eden* (1952). He also wrote the stories for several musical comedies. *Face the Music* (1932) and *As Thousands Cheer* (1933) had music by Irving Berlin, and *Lady in the Dark* (1941) had music by Kurt Weill.

Hart wrote the scripts for several motion pictures, including *Gentleman's Agreement,* which won the 1947 Academy Award as the best movie of the year. He directed many plays and musicals, including the hit musical comedy *My Fair Lady* (1956). His autobiography, *Act One* (1959), is an informative book about theater life. Hart was born in New York City. Frank R. Cunningham

See also **Kaufman, George S.**

Harte, Bret (1836-1902), was an American author who became famous for his colorful stories about the West. His best-known works describe the California gold rush days of the mid-1800's. Harte portrayed reckless and fascinating characters, including gamblers, miners, and prostitutes. His sentimental plots and character descriptions resembled those of the English novelist Charles Dickens. Harte presented vivid descriptions of mountain scenery and believable portrayals of prospectors and their slang. His descriptions helped shape a movement

in American fiction called *local color writing.* This literary style tries to capture the feeling of some particular place and its people.

Harte was born in Albany, New York. His real name was Francis Brett Hart. He moved to California at the age of 17. After publishing several poems in 1857, he decided to be a writer. Two years later, Harte joined the staff of the *Northern Californian* newspaper. In 1860, he wrote an editorial that criticized white Californians for their part in a massacre of Indians. The angry townspeople forced him to resign. Harte later composed a clever series of 15 stories for a weekly magazine, the *Californian.* These stories were collected in a book called *Condensed Novels* (1867). In this work, Harte parodied several well-known novelists of the 1800's. His major literary production of this period was "The Work on Red Mountain" (1860), later revised as "M'liss" (1863), a gloomy story of greed and gold.

From 1868 until early 1871, Harte served as editor of the *Overland Monthly* magazine. The August 1868 issue included his story "The Luck of Roaring Camp." Californians disliked the story at first because it showed California life as rough and unsophisticated and was sympathetic to the tough gold rush miners. But the story soon gained Harte a nationwide reputation.

Harte's work in the *Overland* continued to gain popularity. His best-known writings from the magazine include two enduring short stories, "The Outcasts of Poker Flat" (1869) and "Tennessee's Partner" (1869), and a humorous though unintentionally racist poem, "Plain Language from Truthful James" (1870), later published as "The Heathen Chinee."

Harte became increasingly popular in the East. In 1871, he moved to New Jersey. But Harte's popularity soon declined. He left the United States in 1878 and lived in London from 1885 until his death. Alan Gribben

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Hartebeest, *HAHR tuh BEEST,* is a large African antelope. There are two main kinds, the *red hartebeest* and *Lichtenstein's hartebeest.* The red hartebeest is found in central and southwest Africa. Lichtenstein's hartebeest lives in southern Africa, especially Mozambique and Zambia.

Hartebeests grow from 3 $\frac{1}{2}$ to 5 feet (1.1 to 1.5 meters) high and weigh from 220 to 500 pounds (100 to 225 kilograms). The females are smaller than the males. Both the females and the males have curved horns. Hartebeests have a brown or reddish-brown coat. The red hartebeest is more reddish and slightly smaller than Lichtenstein's hartebeest.

Hartebeests live in open or lightly wooded areas, where they feed on many kinds of grasses. They run rapidly and can easily outrun a lion or a horse. They travel in herds of 10 or more. Hartebeests were once found throughout the grassy plains of Africa, but some populations have become scarce. Anne Innis Dagg

Scientific classification. Hartebeests are in the family Bovidae. The scientific name for the red hartebeest is *Alcelaphus buselaphus.* Lichtenstein's hartebeest is *A. lichtensteinii.*

Hartford (pop. 121,578; met. area pop. 1,183,110) is the capital of Connecticut and one of the largest cities in the state. About 40 insurance companies and subsidiaries have their headquarters in Hartford, which is known as the *Insurance City.* Hartford is also an important manufacturing center. It lies on the west bank of the Connecticut River, in the north-central part of the state. For the location of Hartford, see **Connecticut** (political map).

In 1633, the Netherlands established a trading post in what is now the Hartford area. English settlers from Massachusetts, led by Thomas Hooker, a Congregationalist minister, founded Hartford in 1636. They named the town for the English town of Hertford.

Description. Hartford covers about 18 square miles (47 square kilometers). Constitution Plaza, a modern business center, lies in the heart of the downtown area. Nearby is the Hartford Civic Center, which includes an assembly hall, an exhibition hall, and a sports arena. State House Square in downtown Hartford includes the Pavilion, an indoor shopping mall. The Capitol is located in Bushnell Park in the center of the city (see **Connecticut** [picture: City Place in Hartford]).

Hartford is the home of Trinity College, the Hartford Seminary, and the Hartford Graduate Center. The University of Hartford and St. Joseph College are in nearby West Hartford.

Hartford's landmarks include the Old State House; homes of the authors Mark Twain and Harriet Beecher Stowe; the Connecticut Historical Society; and the Wadsworth Atheneum, one of the first public art museums in the United States. The atheneum was established in 1842.

The Hartford Courant is the oldest continuously published newspaper in the country. The newspaper was founded in 1764.

Economy. Hartford's insurance companies employ about a fifth of the city's workers. The Hartford area has about 2,000 manufacturing firms. The chief manufactured products include aircraft equipment, electrical

Philippa Scott, Photo Researchers

The hartebeest is a large African antelope with curved horns. The red hartebeest, *shown here,* has a reddish-brown coat and a white rump patch. It grazes in herds on the African plains.

equipment, industrial machinery, metal products, and printed materials. The Hartford area has about 4,500 stores and ranks second to Boston as the largest retail center in New England.

Government and history. Hartford has a council-manager government. The voters elect a mayor and nine city council members to two-year terms. The council appoints a city manager to run the city government.

Saukiog Indians lived in what is now the Hartford area before the Dutch founded a trading post there called the *House of Hope*. In 1639, English settlers of the Connecticut Colony met in Hartford and adopted the *Fundamental Orders,* sometimes called the first written constitution. The Fundamental Orders later served as a model for the United States Constitution.

Hartford was incorporated in 1784. New Haven and Hartford were twin capitals of Connecticut from 1701 to 1875, when Hartford became the only capital. In 1835, after a fire in New York City, the Hartford Fire Insurance Company was one of the few insurance firms that was able to pay its claims. As a result, Hartford became known for reliable insurance companies.

The city's population increased from 79,850 in 1900 to 138,036 in 1920 largely because of immigration from Europe. The population reached a high of 177,397 in 1950 but then began to decline as thousands of people moved to suburban areas. The decline continued into the 2000's. Jeff Rivers

For the monthly weather in Hartford, see **Connecticut** (Climate). See also **Charter Oak.**

Hartford, George Huntington (1833-1917), an American merchant, helped develop the retail chain store industry. He and George F. Gilman founded the Great Atlantic and Pacific Tea Company (A&P).

Hartford was born in Augusta, Maine. He worked in a Boston dry-goods house and then went to St. Louis, Missouri. In 1858, he began working as a salesman in a St. Louis store owned by Gilman. The two men later became partners in New York City and operated stores first under the name of the Great American Tea Company. After Gilman retired in 1878, Hartford headed the company. It became the largest in its industry. In 1913, he began developing cash-and-carry stores that set the pattern for today's supermarkets. John B. McFerrin

Hartford Convention was a meeting of New England delegates during the War of 1812 to discuss their opposition to the war and to other United States government policies. The meeting took place in Hartford, Connecticut, from Dec. 15, 1814, to Jan. 5, 1815.

The main opposition to the war came from members of the Federalist Party in New England. They objected to the ruin of New England's shipping trade by the war, and they did not want to help France by fighting the United Kingdom. The Federalists generally opposed France in international disputes.

In 1814, the Massachusetts legislature called a meeting of New England states to discuss their problems. Most of the 26 delegates came from Massachusetts, Connecticut, and Rhode Island. Some people feared that New England would withdraw from the Union and make a separate peace with the United Kingdom. Their fears increased because the Hartford Convention met in secret, but the delegates decided on less drastic action.

The delegates issued a report urging that each New England state be given more control over its own military defense. The report also proposed amendments to the United States Constitution to make it harder for the government to make war or restrict trade. In addition, the delegates recommended amendments to reduce the influence of the South in the government.

The Treaty of Ghent, which ended the War of 1812, was signed while the Hartford Convention met. Nevertheless, Federalist opposition to the war, as shown by the convention, helped destroy the party.

Reginald Horsman

Hartley, Marsden (1877-1943), was one of the first American painters to experiment with Cubism and abstract art. By about 1920 he had returned to a representational style, often using landscape or marine themes. However, his representational paintings show the influence of his earlier abstract work in their emphasis on pattern and simplification of shapes. Hartley's trips abroad during the 1920's and 1930's helped shape his choice of subjects, ranging from Bavarian alps to Mexican deserts. In his later years, he painted some of his most familiar and moving scenes of Maine, honoring the people and the land.

Oil painting on canvas (1941); The Metropolitan Museum of Art, Arthur H. Hearn Fund, New York City

Lobster Fishermen, Corea, Maine is Marsden Hartley's simple but powerful impression of life on the coast of Maine.

Hartley was born in Lewiston, Maine. He studied with artist William Merritt Chase in New York and exhibited in the gallery of photographer Alfred Stieglitz, a supporter of pioneering modern artists. Charles C. Eldredge

Hartmann von Aue (1170?-1210?) was a German poet. He introduced the legends of King Arthur into German literature by adapting *Erec* and *Yvain,* two romances by the French poet Chrétien de Troyes.

In *Erec,* Hartmann retold the story of an Arthurian hero who gave up knighthood for love. *Yvain* is the story of an Arthurian hero who gave up love for knighthood. *Poor Henry* and *Gregorius* are two original verse epics by Hartmann. They deal with sin and redemption. Hartmann also wrote love poetry and crusade songs.

Hartmann was born in Swabia. He was a knight in the service of a Swabian lord. James F. Poag

See also **German literature** (Epic poetry).

Harun al-Rashid, *hah ROON ahl rah SHEED* (766-806), was an important ruler of the Abbasid dynasty, which

governed the Islamic empire during the Middle Ages. In A.D. 786, Harun became *caliph* (ruler) of the empire of the Muslims. At that time, the Muslim empire included northern Africa, part of Spain, most of the Middle East, and part of India. Harun was a patron of learning, music, and the arts. The empire prospered under his rule, and the capital, Baghdad, was a center of culture as well as wealth. Harun was a leading character in the *Arabian Nights,* a famous collection of Arabic folk tales (see **Arabian Nights**).

Early in Harun's reign, his tutor, Yahya ibn Khalid, and Yahya's sons, controlled the government, but Harun later seized control. He fought many wars against the Christian Byzantine Empire, sometimes leading the Muslim army. Harun died in battle. Wilferd Madelung

Harunobu (1725–1770) was a Japanese printmaker. In 1765, he perfected a new technique for making Japanese wood-block prints in many colors. Before then, Japanese artists had made prints in black ink alone, or in black ink with at most two other colors, red and green. Harunobu's prints, called *nishiki-e* (brocade pictures), included as many as 10 colors.

Harunobu's art has been praised for its great refinement and beauty. Most of his wood-block prints portray delicate, doll-like girls in scenes from everyday life. These scenes reflect an atmosphere of serenity and intimacy. The charm of Harunobu's prints was enhanced by the multicolor printing process. Harunobu's birthplace is unknown, but he spent most of his life in Edo (now Tokyo). Robert A. Rorex

See also **Japanese print** (picture: A tranquil nighttime scene).

Harvard, John (1607-1638), was a minister and philanthropist. He left a library of 400 volumes, and about 780 pounds sterling, to the college at Cambridge, Massachusetts, which was later named after him. He was not the founder of Harvard University, but he gave the college its first large gift.

Harvard was born in London. He attended Cambridge University, and received B.A. and M.A. degrees. In 1636, he married Anne Sadler. The following year, he and his wife sailed to Massachusetts. They settled in Charlestown, where he became a minister of the Charlestown church. Robert H. Bremner

Harvard University is the oldest institution of higher learning in the United States. It was founded in 1636, just 16 years after the Pilgrims landed at Plymouth. Harvard is also one of the richest private universities in the United States, with an endowment of over $4 billion. The main campus is in Cambridge, Massachusetts. The university also has several schools in Boston.

Harvard has played an important role in American life. Presidents John Adams, John Quincy Adams, Theodore Roosevelt, Franklin D. Roosevelt, and John F. Kennedy graduated from Harvard. President Rutherford B. Hayes attended Harvard law school.

Educational program. Harvard's 10 graduate and professional schools are open to both men and women. These schools have over half the university's enrollment. The schools of arts and sciences, design, divinity, education, law, and government are on the Cambridge campus. The schools of business administration, dental medicine, medicine, and public health are in Boston.

Many Harvard departments use a tutorial plan. Under the plan, individual students or small groups meet periodically with faculty tutors for instruction in the students' major area of study. Most students who participate in tutorials do not do so until their sophomore year. Most honors candidates in departments with a tutorial plan receive tutorial instruction.

General examinations test the students' grasp of their major field. Students in some fields must pass general examinations to graduate, no matter how high their grades might be. Harvard awards about $145 million in financial aid to its students each year. Undergraduates receive about $43 million of this aid.

The Harvard campus. The Harvard Yard is the center of the original college. Dormitories, libraries, and class buildings in a variety of architectural styles stand near this grassy, shaded area. During the Revolutionary War, General George Washington's troops used Massachusetts Hall as barracks, and the provincial legislature met in Harvard Hall.

Freshmen live in dormitories in and near the Yard, but most other students live in the 12 residential houses. These houses are modeled after the residential colleges of Oxford and Cambridge universities. Harvard's residential houses are more than places where students eat and sleep. They are also centers for social and educational activities. Each house has its own dining hall, library, and athletic facilities. Faculty members live or eat at the house, permitting students to mix informally with instructors. The 12 residential houses are Adams, Cabot, Currier, Dunster, Eliot, Kirkland, Leverett, Lowell, Mather, North, Quincy, and Winthrop. Dudley House has facilities for students who live at home. All university housing is coeducational.

Harvard has the world's largest university library system. Its collection includes more than 12 million books and pamphlets and many manuscripts, maps, microfilms, slides, and other materials. Museums on the campus include the Peabody Museum of Archaeology and Ethnology; the Botanical Museum; the Geological Museum; the Mineralogical Museum; the Museum of Comparative Zoology; the Busch-Reisinger Museum of Central and Northern European Art; the University Herbaria; the Fogg Art Museum; and the Arthur M. Sackler Museum. The Arnold Arboretum has a famous collection of trees and shrubs in Boston.

The university supervises several research facilities outside the Cambridge-Boston area. They include a center for the study of Italian Renaissance culture at Villa I Tatti in Florence, Italy; a center for Byzantine studies in Washington, D.C.; and a center for Hellenic studies, also in Washington. The Harvard experimental forest is located in Massachusetts. The Harvard-Smithsonian Center for Astrophysics in Cambridge is a joint enterprise of Harvard University and the Smithsonian Institution. It is a center for basic research in astronomy, astrophysics, and the space sciences.

History. Harvard College was founded at Newtowne on Oct. 28, 1636. In 1638, Newtowne was renamed Cambridge after Cambridge University in England, where many of the colonists studied. The college opened in 1638. In 1639, it was named after John Harvard, a Puritan minister. Harvard left the college half his estate when he died in 1638. The first class graduated in 1642.

Harvard is the oldest collegiate foundation in North

Harvard University

The Harvard College Yard, center of the original college, still keeps much of its Old World charm and dignity today. This picture comes from an engraving made in the 1770's by Paul Revere, the colonial patriot and silversmith. The small Holden Chapel, *far left,* was built in 1744. The other four buildings, built in the Georgian Colonial style of architecture, are, *left to right,* Hollis Hall, Harvard Hall, Stoughton Hall, and Massachusetts Hall.

America. It still operates under a charter granted in 1650. A corporation of five fellows, together with the president and treasurer *ex officio,* manage the university. A board of 30 overseers, elected periodically by alumni, must approve the acts of the corporation.

Harvard's present educational system was shaped by Charles William Eliot, president of the school from 1869 to 1909. When Eliot came to Harvard, it was a small New England college. When he left, it was a national institution. Under Eliot's leadership, Harvard established the elective studies system, replacing the prescribed classical curriculum, and raised scholarly and professional standards in the graduate branches.

In 1879, Radcliffe College, a private liberal arts college for women, was founded. It was independent but had close ties to Harvard.

Abbott Lawrence Lowell, president of Harvard from 1909 to 1933, refined the elective system to include a tutorial system, specialized fields of study, and general examinations. Under James B. Conant, president from 1933 to 1953, Harvard reorganized professional training in engineering, architecture, and dental medicine. Conant developed the general education program for undergraduates. Under Nathan M. Pusey, president from 1953 to 1971, Harvard placed strong emphasis on international and area studies. The university also strengthened its departments of divinity, education, humanities, social sciences, natural sciences, medicine, and public health.

Derek Bok became president in 1971. During his administration, the number of women students enrolled at Harvard increased greatly, and Harvard and Radcliffe merged their admissions and financial aid offices. In 1979, Harvard introduced a revised general education program for undergraduates. The new program, called the *core curriculum,* makes up about a fourth of each student's course work. Courses in the core curriculum teach students how to approach the study of the major areas of knowledge. In 1991, Neil L. Rudenstine succeeded Bok. In 1999, Radcliffe College merged with Harvard University. Radcliffe College was renamed Radcliffe Institute for Advanced Study, offering a wide range of research and scholarship with a special focus on women, gender, and society. Critically reviewed by Harvard University

See also Eliot, Charles William; Harvard, John; Radcliffe College.

Harvest mite. See Chigger.

Harvest moon is the name given to the full moon that occurs nearest the autumnal equinox. In the Northern Hemisphere, the autumnal equinox occurs on September 22 or September 23. The moon rises at about the same time for several nights. It shines with such brightness that farmers in northern Europe and Canada can work until late at night to take in the fall harvest. In the Southern Hemisphere, the harvest moon occurs in March, at the vernal equinox. C. R. O'Dell

Harvester. See Reaper; McCormick, Cyrus Hall.

Harvesting. See Farm and farming.

Harvey, William (1578-1657), was an English physician who became famous for his discovery of how blood circulates in mammals, including human beings. He described his discovery in *An Anatomical Study of the Motion of the Heart and of the Blood in Animals* (1628). This work became the basis for all modern research on the heart and blood vessels.

Harvey based his discovery on firsthand observations and on dissections of humans and animals. Harvey's findings conflicted with the widely accepted theory of blood circulation originated by Galen, an ancient Greek physician. Galen thought the liver converted food into blood. Galen also believed blood flowed through the veins to the rest of the body, where it was consumed.

Through his experiments, Harvey demonstrated that the heart works like a pump, forcing blood to flow through the arteries to the body. He also showed that the blood returns to the heart through the veins, thus forming a system of closed circulation. In addition, Harvey proved that the pulse is caused by the expansion of the arteries following each contraction of the heart. He showed that the heart's right *ventricle* (pumping chamber) supplies blood to the lungs and that the left ventricle pumps blood to the rest of the body.

Harvey was born in Folkestone, Kent, England. From 1593 to 1599, he studied at Gonville and Caius College in Cambridge. In 1602, he received a doctorate in medicine from the University of Padua. He then began practicing medicine in London. In 1607, he was elected to the Royal College of Physicians. He served as a physician to Kings James I and Charles I. In 1651, Harvey published *Essays on the Generation of Animals,* considered a basis for modern embryology. This work deals with reproduction, particularly the part that the egg plays in reproduction. John Scarborough

Hashish, *HASH eesh,* is a drug that affects the mind. It is obtained from the hemp plant. It usually produces feelings of contentment and relaxation, but it may make a person sad, nervous, or worried. To a person who

takes a strong dose of hashish, colors may appear very bright and flowing. Sound and music may seem alive and touchable. Near objects may appear distant, and minutes may seem like hours. In the United States, Canada, and many other countries, laws prohibit the possession, sale, or distribution of hashish, except for approved medical research.

Most hashish users smoke the drug in a pipe, but some mix it with food or drink. The drug is most powerful when smoked. The effects also depend on the size and purity of the dose, the mood of the user, and the circumstances in which it is used. A chemical in hashish called *Tetrahydrocannabinol* (THC) affects the brain and nervous system. Large amounts may produce *hallucinations,* during which the user sees or hears things that do not exist. A user also may experience *delusions* (false beliefs about reality). In addition, THC decreases muscle coordination. The effects last for several hours.

Hashish does not lead to physical dependence, as do heroin, alcohol, and some other drugs. But some hashish users may become used to taking the drug and find it hard to stop. They may become more interested in taking hashish than in their work, family, or friends.

Hashish is a sticky substance, called a *resin,* that is obtained from the top of the hemp plant. Hemp grows in most parts of the world. But most hashish comes from the Near East and other parts of southern Asia, where it has been used for thousands of years. Donald J. Wolk

See also **Assassination**; **Marijuana**.

Hasidism, *HAS ih dihz uhm,* is a movement in modern Judaism. Followers believe that God is everywhere and that divine light and power touch everything. Therefore, there is no cause for despair or unhappiness. They believe they can best serve God through joyous prayer. In their religious services, followers sing and dance a great deal. They also express their beliefs through storytelling. Hasidism is organized around spiritual leaders called *rebbes.* Each leader heads a local center. Each has his own way of teaching and living and his own interpretation of the Hasidic tradition.

Ba'al Shem Tov, a Jewish teacher, and his followers founded Hasidism in Poland and Lithuania about 1760. The movement spread throughout eastern Europe. By the late 1700's, Hasidic settlements had been established in Palestine. Today, the most important Hasidic centers are located in Jerusalem, Israel, and in the borough of Brooklyn in New York City. Lawrence H. Schiffman

See also **Ba'al Shem Tov**; **Kabbalah**.

Haskalah, *hahs kah LAH,* was a religious cultural movement that tried to modernize traditional Jewish beliefs and practices. *Haskalah* is the Hebrew word for *enlightenment.* The movement began among German and Polish Jews during the late 1700's and gradually spread to other Jewish communities in Europe.

In western Europe, the Haskalah encouraged Jews to dress like non-Jews rather than in traditional Jewish clothing. It called for Jews to adopt the local language instead of relying on Yiddish, a Jewish language. The Haskalah also urged Jews to enter such fields as agriculture, the arts, and science. The movement believed Jews should seek a nonreligious education as well as a Jewish education. Its leaders hoped to draw Jews into the mainstream of western European culture.

The Haskalah greatly affected Jewish life. It was responsible for starting modern Hebrew literature and Jewish newspapers. The Haskalah movement helped develop a national and critical approach to the study of Judaism and its holy books. At the same time, it caused many Jews to lose their faith and seek to become totally absorbed into European society. Many attitudes of the Haskalah were adopted by the Jewish nationalist movement known as Zionism and greatly influenced the founders of the state of Israel. Lawrence H. Schiffman

Hassam, *HAS uhm,* Childe (1859-1935), was an American painter. His most important paintings show the influence of the French impressionist movement of the late 1800's. Like many French impressionists, Hassam used patchy brushstrokes to try to capture the effects of sunlight and atmospheric conditions, such as mist. But Hassam's pictures have more solid figures, an increased use of black, and a greater use of perspective than the works of the impressionists.

Frederick Childe Hassam was born in Dorchester, Massachusetts. He met the impressionists while studying painting in Paris. In the 1890's, he painted scenes of New York City in a lively style. During the early 1900's, Hassam painted scenes of the New England seashore and countryside. Many of these pictures portray towns with white churches outlined against dark pine trees and blue skies. Sarah Burns

Hassan II, *HAH sahn* (1929-1999), was king of Morocco from 1961 until his death in 1999. He was succeeded by his son Sidi Muhammad, who became king as Muhammad VI. Under Hassan's leadership. Morocco expanded mining and other industries, irrigated desert land, and built hundreds of schools.

Hassan was born in Rabat. He was educated in Morocco and in France, where he earned a law degree. He succeeded his father, Muhammad V, as king in 1961. Hassan wrote Morocco's first constitution, which was adopted in 1962. The constitution made the nation a constitutional monarchy governed by the king and a parliament. The parliament blocked Hassan's economic program, and, in 1965, he took full control of the government. Another parliament was elected in 1970. Hassan took full control of the government again in 1972 after Moroccan military leaders tried to assassinate him, but another parliament was elected in 1977.

In 1976, Spain gave up its control of Spanish Sahara, an area that borders Morocco on the south. Hassan claimed the area, now called Western Sahara, as Moroccan territory. But the Polisario Front, made up of people who live in Western Sahara, opposed him. Fighting broke out between Moroccan and Polisario Front forces and continued into the 1990's. A cease-fire was declared in 1991. In spite of the war's high costs and its burden on Morocco's economy, Hassan retained the loyalty of most of his subjects. Kenneth J. Perkins

See also **Morocco** (Constitutional monarchy).

Hassium is an artificially produced radioactive element with 108 protons—that is, with an *atomic number* of 108. Scientists have discovered four *isotopes* of hassium, forms of the element with the same number of protons but different numbers of neutrons. The *atomic mass numbers* (total number of protons and neutrons) of these isotopes are 263, 264, 265, and 267. The most stable isotope has a mass number of 263 and a *half-life* of 1 second—that is, due to radioactive decay, only half the

atoms in a sample of isotope 263 would still be atoms of that isotope after 1 second.

In 1984, scientists at the Heavy Ion Research Center in Darmstadt, West Germany (now part of Germany), announced the production of the element. They claimed that they had produced three atoms of it with mass number 265. They bombarded lead, whose atomic number is 82, with iron, which has an atomic number of 26.

Scientists at the Joint Institute for Nuclear Research in Dubna, near Moscow, made a rival claim in 1984. Dubna was then part of the Soviet Union and is now in Russia.

In 1986, the International Union of Pure and Applied Chemistry (IUPAC) and the International Union of Pure and Applied Physics formed a working group to review the histories of the elements with atomic numbers from 101 to 109. IUPAC is the recognized authority in crediting the discovery of elements and assigning names to them. The working group concluded that, though the Soviets had probably produced the element, the West Germans deserved the credit for its discovery because their experiments were more detailed. The experiments at Darmstadt provided definitive evidence for the atomic number and atomic mass of isotopes of the element.

In 1993, IUPAC accepted the working group's conclusion. Disagreements about what to name the element delayed an official naming until 1997, however. The name *hassium* comes from *Hasse,* Latin for *Hesse,* the German state where Darmstadt lies. The chemical symbol for hassium is Hs. Before the element got its official name, it was referred to as *element 108.* Richard L. Hahn

Hastert, J. Dennis (1942-), an Illinois Republican, became speaker of the United States House of Representatives in 1999. Newt Gingrich had resigned from the office in 1998. Bob Livingston was supposed to succeed Gingrich, but he decided not to take the office. Hastert was then chosen speaker.

John Dennis Hastert, who is usually known by his middle name, was born in Aurora, Illinois. He earned a bachelor's degree from Wheaton College in 1964 and a master's degree from Northern Illinois University in 1967. He was a high school government and history teacher from 1964 to 1980.

Hastert served as a member of the Illinois House of Representatives from 1980 to 1986. He was elected to the United States House of Representatives in 1986 and took office in 1987. Hastert held the post of chief deputy majority whip of the U.S. House before he became speaker.

Hastie, William Henry (1904-1976), was the first African American to become a judge of the U.S. Court of Appeals. He was appointed in 1949 by President Harry S. Truman and served from 1950 until he retired in 1971. From 1937 to 1957, Hastie served on the board of directors of the National Association for the Advancement of Colored People (NAACP). He was dean of the Howard University School of Law from 1939 to 1946. From 1946 to 1949, he served as governor of the Virgin Islands. Hastie was awarded the Spingarn Medal in 1943. He was born in Knoxville, Tennessee. David M. O'Brien

Hastings, *HAY stihngz,* **Battle of** (Oct. 14, 1066), marked the beginning of the conquest of England by William, Duke of Normandy. Historians rank it among the major battles that changed the course of history.

Harold Godwin was chosen king of England in 1066, after Edward the Confessor died. But William of Normandy claimed that Edward, his cousin, had promised him the English throne. Harold prepared to defend the coast against an attack, as William enlisted knights from Normandy and northern France. But the king of Norway suddenly invaded northern England to claim the throne. Harold took his troops north on a forced march. His Anglo-Saxon forces defeated the Norse near York.

In Harold's absence, William landed his army on England's southern coast. Harold hastened south with his weary forces and gathered such militiamen as he could from the south. He met William's invading troops at the hill of Senlac, near the town of Hastings. Harold almost won a second major victory in three weeks in the day-long battle. Although the details of the fighting are unclear, historians think Harold's men held the top of the hill. Then the Normans pretended to retreat, causing the English militia on the flanks to rush down the hill in pursuit. The Normans split the English formation, cutting the separate elements of the enemy army to pieces. A Norman arrow killed Harold. But it took William five more years to complete his conquest. Joel T. Rosenthal

See also **Harold II; William I, the Conqueror; Bayeux Tapestry.**

Hastings, *HAY stihngz,* **Warren** (1732-1818), was the first governor general of India. He extended British rule in India and improved the courts and tax systems. He also encouraged the study of Indian culture.

Hastings was born in Oxfordshire, England. In 1750, he went to India as a clerk with the East India Company, a British trading company. In 1772, he was appointed governor of Bengal, and in 1774, he was named governor general. He resigned in 1785 and returned to England. There, political enemies led by dramatist Richard Brinsley Sheridan and statesmen Edmund Burke and Charles James Fox accused him of betraying British ideals of justice and fair play. They impeached him on charges of corruption and misuse of power. After a trial that lasted from 1788 to 1795, Hastings was *acquitted* (declared innocent). Brijen K. Gupta

Hat is the name of any of several kinds of coverings for the head. A hat consists of a *crown,* the part that fits on the head; and, in most cases, a circular *brim.* Hats differ from other head coverings, such as bonnets, caps, helmets, and hoods, most of which have a small brim or no brim at all. But the word *hat,* as used in this article, refers to such brimless headgear as well.

Hats vary widely in material and style, depending largely on the climate and people's customs. People also wear hats as an accessory to other clothing.

Throughout the centuries, the desire of people to be fashionable has resulted in many kinds of unusual hats. During the 1400's, many European women wore a tall, cone-shaped hat called a *hennin.* This hat measured from 3 to 4 feet (0.9 to 1.2 meters) high and had a long, floating veil. The *Gainsborough hat* became popular with both men and women in the late 1700's. It had a wide brim and was decorated with feathers and ribbons.

Why people wear hats. People wear hats for (1) protection, (2) communication, and (3) decoration.

People probably first began to wear hats to protect themselves from the climate. In hot, sunny climates, wide-brimmed hats provide shade from the sun. Many Mexicans wear such hats, called *sombreros,* which are

made of felt or straw. In cold climates, people often wear fur or wool hats. Some farmers in Russia wear heavy fur hats. And the Lapps of far northern Europe wear tight-fitting wool hats that have earflaps. Hats also provide protection. For example, construction workers, football players, and military personnel wear metal or plastic helmets for protection from injury.

Hats can communicate various things about the people who wear them. The hats of coal miners, firefighters, and matadors indicate the wearer's occupation. Among members of the religious group known as the *Amish,* the width of the hat brim and the height of the crown can communicate whether the wearer is married.

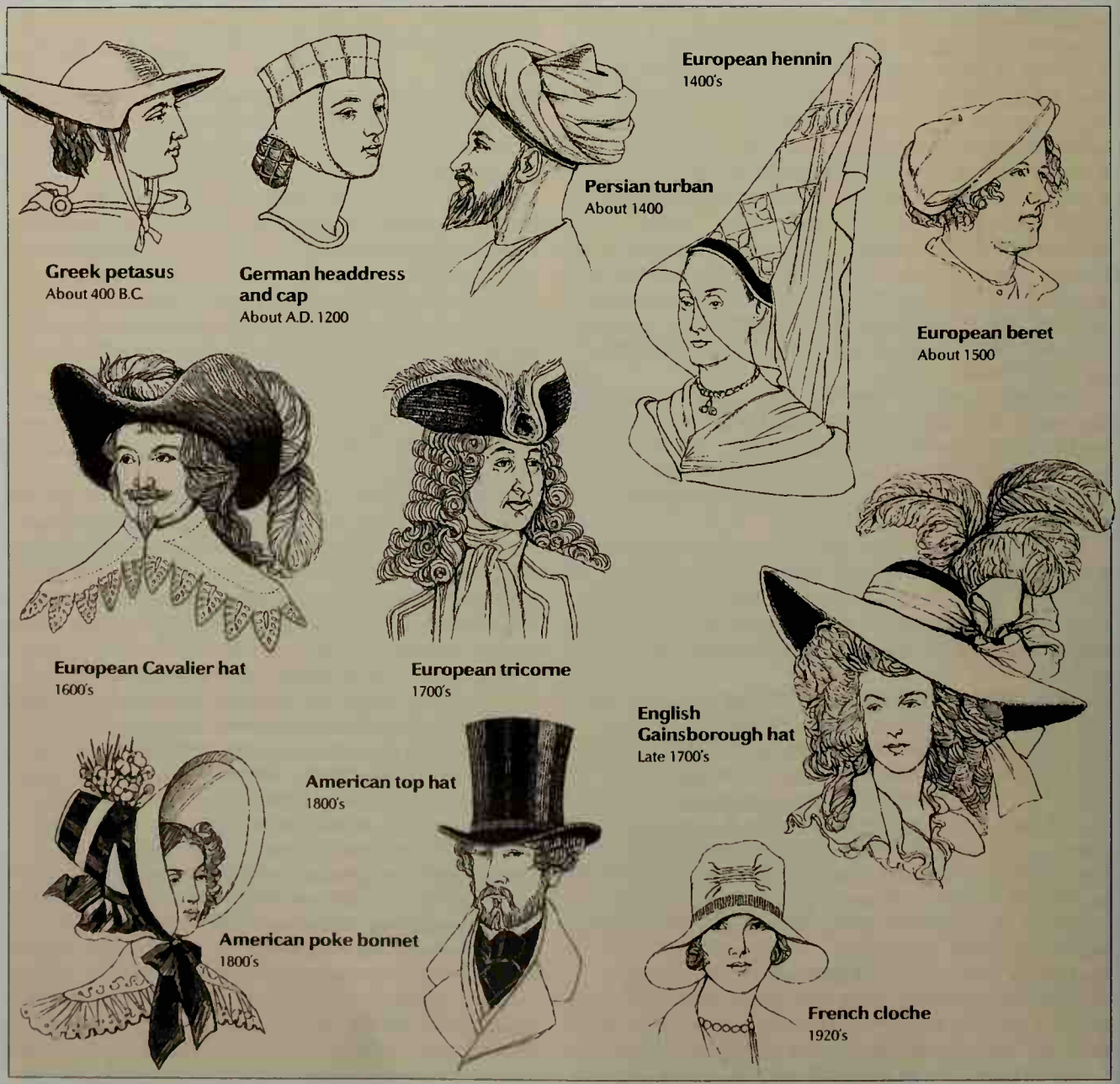
Most people wear a hat that they believe makes them look attractive, though the hat's main purpose may be protection or communication. Fur hoods and rain hats may be attractive and stylish. Even the caps of police officers and military personnel are designed to improve the wearer's appearance. Certain decorative hats are worn as a tradition. In Scotland, for example, people wear a cap called a *tam-o'-shanter* that is part of their traditional costume. A South American cowboy's traditional costume includes a felt gaucho hat.

History. No one knows when people first wore hats. People in various cold climates may have worn fur hoods 100,000 years ago.

Through the centuries, people also wore hats to indicate their social status. In ancient Egypt, the nobility wore crowns as early as 3100 B.C. Some ancient Greeks wore hats known as *pelos.* These hats were usually made from wool fibers. Pelos can still be found in parts of southern Siberia today. They are similar to the brim-

Some hats of the past Hat styles have varied widely throughout history for several reasons, including changes in fashion and the use of different materials in making headwear. Most hats of the past have gone out of style. But varieties of some hats, such as the beret and the turban, are still worn.

WORLD BOOK illustrations by Anthony Saris



Some kinds of hats worn today

People wear hats for several reasons. Hats may be worn for protection from the climate or from injury; for communication, or for decoration. Reasons for wearing hats cause variety in hat styles.

For communication

H. Taylor, De Wys, Inc.

Bishop in Greece

For decoration

Woodfin Camp, Inc.

Woman in Africa

For protection

Paul Robert Perry

U.S. Construction worker

Howard Sochurek, Woodfin Camp, Inc.

Herdsman in Siberia

less, tasseled hat known as a *fez* (see Fez).

By the A.D. 1300's, people wore hats increasingly for decoration, resulting in the development of a large variety of hats and frequent changes in styles. People in one area often adopted the hat styles worn in another. During the 1300's and 1400's, for example, women in western Europe wore a type of hat that resembled a turban. They adopted this style from the headgear worn by people who lived in the Middle East and Asia.

Zadoc Benedict, a craftworker, established the first hat factory in the United States in 1780 in Danbury, Connecticut. In 1851, John Nicholas Genin, a New York City manufacturer, made the first soft felt hats for women.

During the 1900's, hat styles varied more widely than ever before. In the 1920's, women wore a drooping, bell-shaped hat called the *cloche*. In the 1930's, they wore the *harlequin hat,* which had a wide, upturned brim. A variety of hats were worn in the 1940's and 1950's. Since the 1960's, hats have been less popular among both women and men. Lois M. Gurel

See also Clothing (Traditional costumes); Helmet; Stetson, John B.

Hatch Political Activities Act is a law that limits the political activities of United States government employees. The act was passed by Congress in 1939 and has been amended several times since then. It was named for its sponsor, Senator Carl Hatch of New Mexico.

The Hatch Act prohibits most federal employees from running in elections for government office. It also forbids them to promise employment, payment, or other benefits for any political activities, including the support of a candidate or party in any election. This prohibition applies to caucuses and conventions as well as to primary, general, and special elections. However, the Hatch Act, as amended, does allow federal employees to participate in other political activities on their own time, and to hold office within a political party.

A 1940 amendment to the Hatch Act extended some of the act's provisions to most state and local employees in federally funded projects. The Federal Election Campaign Act of 1974 repealed parts of the Hatch Act that barred state employees from participating in party politics. The Hatch Act Reform Amendments of 1993 changed the act to allow federal employees to participate in political activities while off duty. Such participation was previously prohibited. Kenneth Janda

Hatcher, Richard Gordon (1933-), became one of the first blacks to win election as mayor of a major United States city. Hatcher, a Democrat, served as mayor of Gary, Indiana, from 1968 through 1987.

Hatcher was born in Michigan City, Indiana. He worked his way through college and graduated from Indiana University and the Valparaiso University School of Law. In 1959, he moved to Gary and began practicing law in nearby East Chicago, Indiana. From 1961 to 1963, Hatcher served as a deputy prosecutor for Lake County, Indiana. He was elected to Gary's city council in 1963.

Hatcher ran for mayor of Gary in 1967 in spite of opposition from local Democratic Party leaders. He waged an uphill fight to win the Democratic primary election and then won an unexpected victory in the general mayoral election. Blacks cast most of the votes. However, many white voters also supported him. He took office at the start of 1968. Hatcher won reelection in 1971, 1975, 1979, and 1983. He was defeated in a bid for another term in the 1987 Democratic primary. He also ran in 1991 but lost the primary. Charles V. Hamilton

Hate crime is a crime committed by an offender because of the victim's race, ethnic background, religion, or sexual orientation. A hate crime can be directed against an individual or a group. Hate crimes may involve vandalism, assault and battery, or intimidation through threats or harassment.

In the United States, the federal government, nearly all states, and many local governments have passed hate crime laws. These laws make an otherwise regular crime a hate crime—and increase the penalty for it—if the crime has been motivated by prejudice. Hate crime laws differ in the number and kinds of prejudices they cover.

Hate crime has long occurred worldwide, but the term did not come into widespread use until the 1980's. In the United States, the first hate crime laws at the local, state, and federal levels were passed during the 1980's and early 1990's. Until the early 1990's, some hate crime laws outlawed cross burnings and similar acts. Groups such as the Ku Klux Klan burn crosses to frighten people they dislike. In 1992, the United States Supreme Court ruled unconstitutional a Minnesota law that forbade

such behavior. The court ruled that the law violated the U.S. Constitution's guarantee of freedom of expression. In 1993, the Supreme Court upheld hate crime laws that increase the penalty for a crime when the victim is selected based on his or her race, religion, or other characteristics. The Canadian government enacted Canada's first hate crime laws in the 1970's. Charles F. Wellford

See also **Anti-Semitism; Prejudice; Racism.**

Hatshepsut, *hat SHEP soot* (?-1469 B.C.?), was the fourth female pharaoh in Egyptian history. The daughter of King Thutmose I and his chief wife, Queen Ahmose, Hatshepsut married her half-brother, King Thutmose II. When Thutmose II died unexpectedly about 1490 B.C., Hatshepsut's stepson, Thutmose III, inherited the throne. But because he was too young to rule, Hatshepsut served as *regent* (temporary ruler).

Within a few years, and with the support of the priests of the god Amon, Hatshepsut had herself crowned pharaoh alongside her stepson. Because Egyptians believed their kings were divine, she justified her new role by claiming to be the god Amon's daughter. She also had herself represented as a man on monuments.

As pharaoh, Hatshepsut encouraged trade and sent an expedition to the land of Punt, somewhere on the northeast coast of Africa. She also sponsored a vast building program at home. She added to the temple of Amon at Karnak and built for herself a great memorial temple, known today as Deir el-Bahri. These monuments, though badly damaged when Thutmose III attacked Hatshepsut's memory after her death, have preserved her fame into the present day. William J. Murnane

Hatteras, Cape. See **Cape Hatteras.**

Hauptmann, *HOWPT mahn,* **Gerhart,** *GAYR hahrt* (1862-1946), a German dramatist, won the Nobel Prize for literature in 1912. Hauptmann's early plays are outstanding examples of naturalistic literature. These early works attempt objectively to portray suffering people whose existence is determined by their environment and by heredity (see **Naturalism**).

Hauptmann was born in Silesia, then part of eastern Germany. He used this region's dialect in many of his plays. Hauptmann gained acclaim for his naturalistic plays *Before Sunrise* (1889) and *The Weavers* (1893). *The Weavers,* his best-known play, describes the plight of exploited Silesian weavers and their revolt against their employers. His other works include the comedies *The Beaver Coat* (1893) and *The Rats* (1910). He also wrote historical and mythological dramas, plays based on fairy tales, poetry, and prose fiction. Walther L. Hahn

Hausa, *HOW sah,* are a black people of west Africa. The approximately 7 million Hausa make up an important cultural and political group in northern Nigeria and southern Niger. Most of them are Muslims.

The first Hausa settlements were probably built during the 1000's or 1100's. By the 1300's, many Hausa city-states had developed, including Kano, Katsina, Sokoto, and Zaria. For location, see **Nigeria** (political map). These city-states became important trade centers.

The Songhai Empire controlled the Hausa states for much of the 1500's (see **Songhai Empire**). The states then became independent again and, in the 1600's and 1700's, engaged heavily in gold and slave trading.

In the early 1800's, local Fulani people who were Muslims led a revolt against the traditional leaders of the city-states. The Fulani and Muslim Hausa rebels conquered many of the city-states and established a Hausa-Fulani empire (see **Fulani**). The British colonized Nigeria in the late 1800's, but the Hausa-Fulani areas remained largely self-governing. Nigeria gained independence in 1960, and the Hausa have since played a major role in Nigerian politics. Leo Spitzer

See also **Niger** (People; picture); **Nigeria** (People).

Havana, *huh VAN uh* (pop. 2,119,059), is the capital, chief port, and largest city of Cuba. It lies on the island's northwest coast, about 100 miles (160 kilometers) south of Key West, Florida (see **Cuba** [political map]). Havana's name in Spanish, the language of Cuba, is *La Habana.*

During the first half of the 1900's, Havana was a popular vacation center. But tourism from the United States virtually disappeared after Fidel Castro became prime minister of Cuba in 1959. Cuba became a socialist state, and in 1961, the United States broke diplomatic relations with Cuba. Today, Americans visit Cuba chiefly for professional meetings or to conduct research. However, tourism from Europe has risen since the mid-1980's, with the building of new hotels and resorts and the completion of improvements to Havana's international airport.

The city of Havana covers about 286 square miles (740 square kilometers). Spanish colonists built Havana in 1519 next to a large natural harbor. Morro Castle, a Spanish fort dating from the late 1500's, guards the entrance to the harbor.

Old Havana, the colonial part of the city, is west of the harbor. Tile-roofed houses, built in the 1500's and 1600's, line the narrow streets. This historic area includes the famous Havana Cathedral, built in the early 1700's, and the Spanish governor's palace. The former Capitol and many government buildings are in downtown Havana, west of the old city. Newer residential areas and suburbs lie west of downtown Havana. The Malecón, a beautiful boulevard, runs along the coast and connects the western residential areas with downtown Havana.

Education and cultural life. The government controls Havana's schools, and education is free. Many adults attend night school and job-training classes. The university is Cuba's largest school of higher education.

Havana's cultural attractions include the Havana Symphony and the internationally acclaimed, government-sponsored National Ballet. The Museum of Fine Arts features classical and modern art. The Museum of the Revolution, the Colonial Museum, and the Municipal Museum are historical museums.

Economy. Havana is the commercial and industrial center of Cuba. The government owns all industries. Health care is an important service industry in Havana. Most of the city's workers are employed by government agencies or small factories. Some people in Havana operate their own small private businesses.

Havana's most important manufacturing activity is the processing of tobacco. Other industries produce beer, chemicals, food products, shoes, and textiles. About a fifth of Cuba's exports and over half its imports pass through Havana.

An international airport serves Havana. Buses provide most of the transportation within the city.

Government. A Municipal Committee governs Havana. Local workers' groups, made up of members of the Cuban Communist Party, elect committee members.

© John Dominis, Wheeler Pictures

Havana is the commercial and industrial center of Cuba. Downtown Havana has many modern office buildings.

History. Diego Velázquez, the first Spanish governor of Cuba, founded Havana on the island's south coast in 1515. But the city failed to flourish, probably because of pirate attacks, and was rebuilt on its present site in 1519. Havana's location and its harbor attracted many trading ships. The city soon developed into an important commercial center. Havana became the capital of Cuba in 1589. By 1600, 4,000 people lived there.

British troops captured the city in 1762 and held it for nearly a year. The British occupation opened up trade between Havana and the British colonies of North America. The increased trade helped the city's population grow to more than 50,000 by the late 1700's.

In 1898, the United States battleship *Maine* exploded mysteriously in Havana Harbor. This event helped bring about the Spanish-American War.

During the first half of the 1900's, the Cuban government spent much money to make Havana a resort center. American companies invested heavily in Havana businesses. Thousands of visitors from the United States and other countries poured into Havana. But despite Havana's prosperity, many of its people lived in poverty.

Since the revolution of 1959, the Cuban government has invested much of its economic resources in the development of the rural areas rather than Havana and other large cities. As a result, Havana has several serious problems. One of the city's most critical problems is a housing shortage. During the 1960's, the government nationalized many hotels and seized the mansions of people who left Cuba and converted these dwellings into public housing. The government has also built some new housing, as well as office buildings and hospitals.

Ivan A. Schulman

See also **Cuba; Spanish-American War.**

Havanese, *HAH vuh NEEZ,* is a small, lively breed of dog. It stands about 10 inches (25 centimeters) high at the shoulders and weighs about 12 pounds (5.4 kilograms). The breed has a long, double coat of soft hair. This coat may be straight or curly and comes in a variety of colors. Havanese have short, muscular legs; large, almond-shaped eyes; drooping ears; and a short snout.

Ancestors of the Havanese originally came from the Mediterranean area of Europe, especially coastal Spain and Italy. By the 1500's, European explorers had brought these dogs to what is now Cuba. The breed was developed in Cuba and named *Havanese* after the Cuban capital, Havana. Havanese are happy, affectionate dogs that make excellent pets.

Mary Bloom © American Kennel Club

The Havanese has drooping ears and long, soft hair.

Critically reviewed by the Havanese Club of America

Havel, *HAH vehl,* Václav, *VAH tslahv* (1936-), became president of the Czech Republic in 1993. He had served as president of Czechoslovakia from 1989 until shortly before that country split into the Czech Republic and Slovakia in 1992. Havel is also an internationally known playwright.

Havel was born in Prague, then part of Czechoslovakia. Czechoslovakia became a Communist country in 1948. The Communist government jailed Havel several times for his efforts to increase human rights in the country. It also banned his outspoken plays. In 1989, Havel founded the Civic Forum, a political organization. The Communists lost control of the government, and the national legislature elected Havel president. In free elections held in 1990, the Civic Forum and an allied party won a majority of the seats in the legislature. The new legislature reelected Havel president.

Meanwhile, a movement grew among Czechoslovaks to split the country into two nations, one for each of the country's two main ethnic groups, the Czechs and the Slovaks. The split of Czechoslovakia was completed at the end of 1992. In January 1993, the legislature of the new Czech Republic elected Havel president.

Stuart D. Goldman

Haversian canals, *huh VUR shuhn,* are tiny channels within *compact bone tissue,* the hard, outer layers of bone. Each canal contains blood vessels, *lymph* (tissue fluid) vessels, connective tissue, and nerves. The blood vessels carry nourishment from larger vessels in the *periosteum* (membrane covering the bone) to the bone tissue. Layers of bone tissue surround each canal to form a cylinder. A canal and its bone tissue are called an *osteon* or *Haversian system.* Osteons are the basic structures that make up compact bone. Haversian canals were first described by Clopton Havers, an English anatomist, in the late 1600's.

Madison B. Cole, Jr.

Camera Hawaii

Hawaii's tropical splendor includes colorful plant life and beautiful beaches along the Pacific Ocean. Diamond Head, *shown here,* an extinct volcano, is a famous Hawaiian landmark. It lies on the island of Oahu, the most thickly populated of the eight main Hawaiian islands.

Hawaii *The Aloha State*

Hawaii, *huh WY ee* or *huh WAH ee,* is the only state in the United States that does not lie on the mainland of North America. It is made up of islands near the middle of the North Pacific Ocean. Honolulu, the capital and largest city, is about 2,400 miles (3,860 kilometers) southwest of the U.S. mainland. Hawaii is also the southernmost state. Oahu, the island on which Honolulu is located, is as far south as central Mexico. Hawaii, the youngest state, joined the Union on Aug. 21, 1959.

Hawaii is world famous for its beauty and pleasant climate. It has deep-blue seas, brilliantly colored flowers, graceful palm trees, and magnificent waterfalls. These attractions provide some of the most thrilling scenery in the United States. Cool Pacific winds keep Hawaii pleasantly mild all year around.

Hawaii has many colorful ways of life. Some of these customs come from Pacific Islanders called *Polynesians,* who were the original settlers of Hawaii. Many of the people of Hawaii are of Polynesian descent. The people's great friendliness toward tourists gives Hawaii its nickname of the *Aloha State. Aloha* means *love* in the Hawaiian language.

When vacationers arrive in Hawaii, they often receive *leis* (wreaths of flowers strung together). The visitors enjoy feasts, folk dancing, parades, and many special events. The hula has become a symbol of Hawaii. Hula dancers sway their hips and move their arms and hands to the music of Hawaiian guitars and other instruments.

The state has many nationality and ethnic groups. In addition to the people of Polynesian descent and whites and blacks from the mainland, Hawaii's population includes many citizens of Chinese, Filipino, Japanese, Korean, and Southeast Asian ancestry. All these people have contributed customs to a colorful life.

Hawaii consists of a chain of 132 islands. The chain extends for 1,523 miles (2,451 kilometers). The eight main islands at the southeastern end of the chain extend about 350 miles (565 kilometers). Almost all the people of Hawaii live on seven of these eight islands.

The contributors of this article are Pauline N. King, Associate Professor of History, and Lyndon Wester, Associate Professor of Geography, both at the University of Hawaii.

Camera Hawaii

The streets of downtown Honolulu are lined with palm trees and modern office buildings. Honolulu, which lies on the island of Oahu, is Hawaii's capital and largest city.

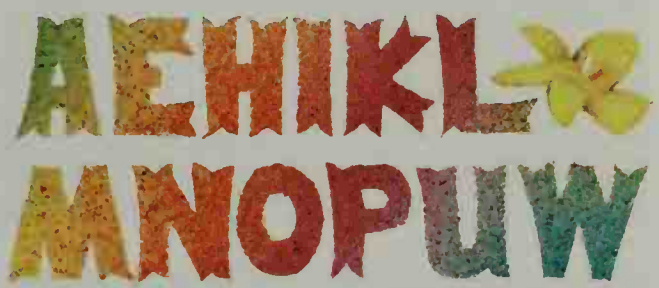
Interesting facts about Hawaii

WORLD BOOK illustrations by Kevin Chadwick

Haleakala Crater

Haleakala has the world's largest dormant volcanic crater. The crater, on the island of Maui, measures about 20 miles (32 kilometers) around and is about 3,000 feet (914 meters) deep.

The southernmost point of the United States is Ka Lae, also called South Point, on the island of Hawaii. *Ka Lae* means *The Point.*



Hawaiian alphabet

The Hawaiian alphabet has only 12 letters—*a, e, h, i, k, l, m, n, o, p, u,* and *w.*

Hawaii was an independent monarchy. Polynesian monarchs ruled the islands from 1795 to 1894, when the islands became a republic. No other U.S. state ever had this form of government.

The wettest place on earth is Mount Waialeale, on the island of Kauai. The average annual rainfall on the mountain is 460 inches (1,168 centimeters).

The state's location in the Pacific Ocean gives it a major role in U.S. military planning. The U.S. Army, Navy, Air Force, and Marine Corps units in the Pacific area are under a single command headquartered in Hawaii. The salaries of military personnel and civilian employees at these bases provide an important source of income in Hawaii. Food processing is Hawaii's leading manufacturing activity.

Most of the world did not know of the Hawaiian islands until 1778. Captain James Cook of the British Navy reached them that year. Local chiefs ruled the islands until about 1800, when the area was united under a Hawaiian king. The islands became a republic in 1894. Hawaii became a U.S. possession in 1898, and a U.S. territory in 1900. It is the only state that was once an independent monarchy.

Hawaii was the first part of U.S. territory to be attacked in World War II. On Dec. 7, 1941, planes of the Japanese navy bombed the naval base at Pearl Harbor and other military installations.

For the relationship of Hawaii to other Pacific Island groups, see the article on the **Pacific Islands**.

Camera Hawaii

Volcanoes formed the Hawaiian islands. Many of the volcanoes are no longer active. But Hawaii, the largest Hawaiian island, has active volcanoes, including Kilauea, *shown here.*

Hawaii in brief

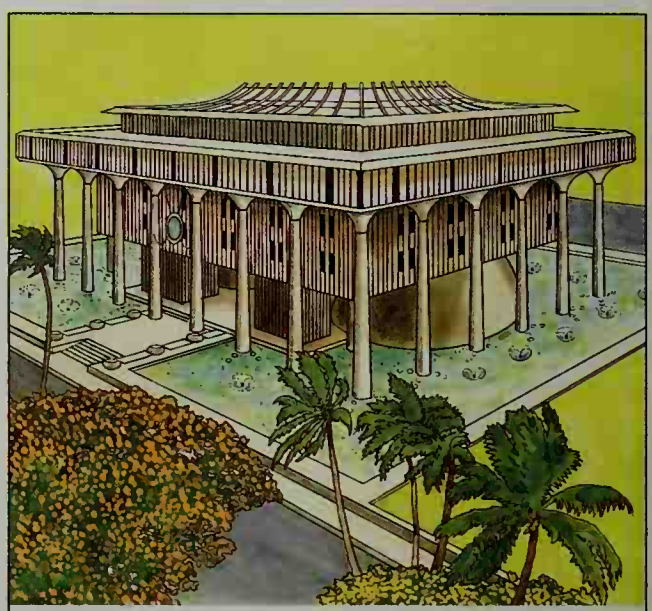
Symbols of Hawaii

Both the state flag and the state seal were adopted in 1959. The flag has eight stripes of alternating red, white, and blue that represent the eight major islands of Hawaii. The state seal bears, in Hawaiian, the state motto, which translates: *The Life of the Land Is Perpetuated in Righteousness.* The state coat of arms is in the center, with a figure of King Kamehameha I to the left and the Goddess of Liberty to the right.

State flag

State seal

Hawaii ranks 47th in size among the 50 states.



The State Capitol is in Honolulu, the capital of Hawaii since it became a state in 1959.

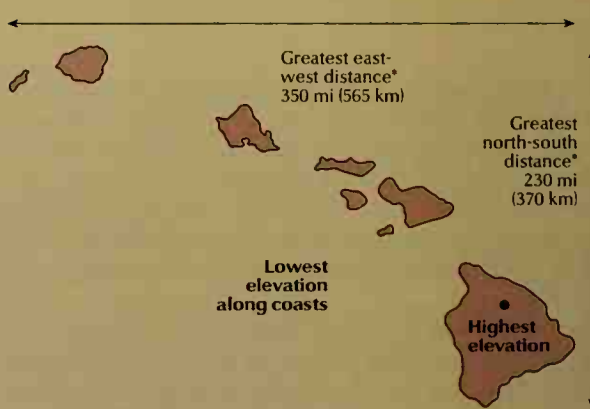
General information

Statehood: Aug. 21, 1959, the 50th state.
State abbreviation: HI (postal).
State motto: *Ua Mau ke Ea o ka 'Āina i ka Pono* (The Life of the Land Is Perpetuated in Righteousness).
State song: "Hawaii Ponoi" ("Hawaii's Own"), words by King Kalakaua; music by Henry Berger.

Land and climate

Area: 6,459 mi² (16,729 km²) including 36 mi² (93 km²) of inland water.
Elevation: *Highest*—Mauna Kea, 13,796 ft (4,205 m) above sea level. *Lowest*—sea level along coast.
Coastline: 750 mi (1,207 km).
Record high temperature: 100 °F (38 °C) at Pahala on April 27, 1931.
Record low temperature: 12 °F (−11 °C) at Mauna Kea on May 17, 1979.
Average July temperature: 75 °F (24 °C).
Average January temperature: 68 °F (20 °C).
Average yearly precipitation: 110 in (279 cm).

*Figures are for main islands only. Entire island chain extends northwest for about 1,500 miles (2,400 kilometers).



Important dates

- **1778** — Captain James Cook of the British Royal Navy reached Hawaii.
- **1835** — The first permanent sugar plantation in Hawaii was started on Kauai Island.
- **c. 1885** — The pineapple industry began with the importation of Jamaican pineapple plants

State bird
Nene (Hawaiian goose)

State flower
Yellow hibiscus

State tree
Kukui

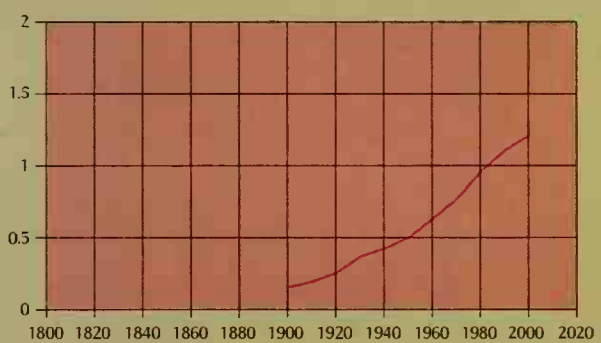
People

Population: 1,211,537 (2000 census)
Rank among the states: 42th
Density: 188 per mi² (72 per km²), U.S. average 78 per mi² (30 per km²)
Distribution*: 89 percent urban, 11 percent rural
Largest cities in Hawaii

Honolulu†	371,657
Hilo†	40,759
Kailua†	36,513
Kaneohe†	34,970
Waipahu†	33,108
Pearl City†	30,976

†Unincorporated place.
Source: 2000 census, except for *, where figures are for 1990.

Population trend



Source: U.S. Census Bureau.

Year	Population
2000	1,211,537
1990	1,115,274
1980	964,691
1970	769,913
1960	632,772
1950	499,794
1940	422,770
1930	368,300
1920	255,881
1910	191,874
1900	154,001

Economy

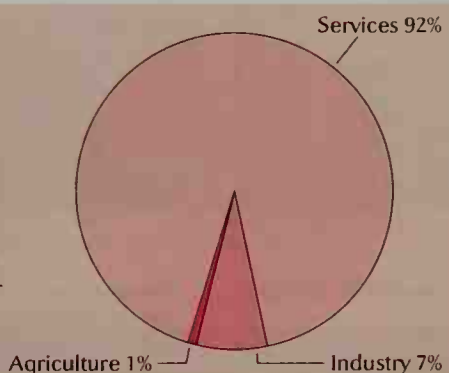
Chief products

Agriculture: sugar cane, pineapples, flowers.
Manufacturing: food products, printed materials, petroleum products.
Fishing industry: swordfish, bigeye tuna.

Gross state product

Value of goods and services produced in 1998: $39,713,000,000. *Services* include community, business, and personal services; finance; government; trade; and transportation, communication, and utilities. *Industry* includes construction, manufacturing, and mining. *Agriculture* includes agriculture, fishing, and forestry.

Source: U.S. Bureau of Economic Analysis.



Government

State government

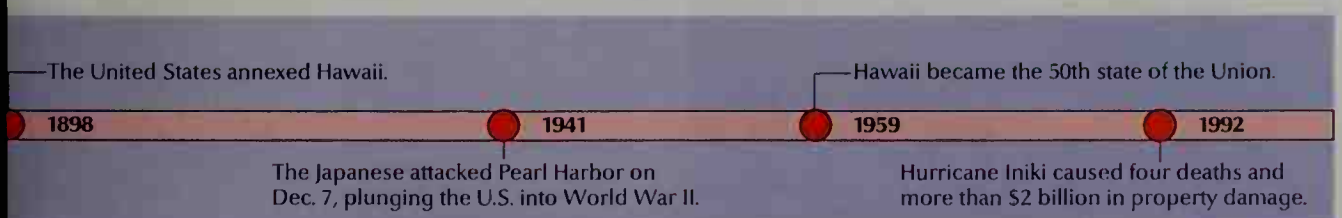
Governor: 4-year term
State senators: 25; 4-year terms
State representatives: 51; 2-year terms
Counties: 5

Federal government

United States senators: 2
United States representatives: 2
Electoral votes: 4

Sources of information

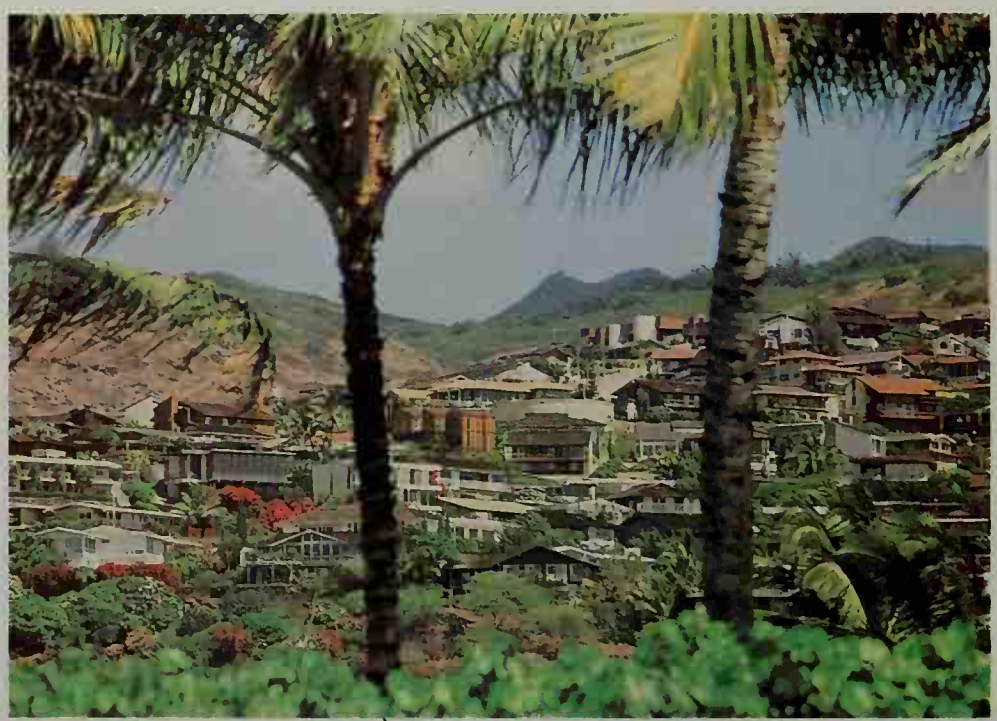
For information about tourism, write to: Hawaii Visitors and Convention Bureau, 2270 Kalakaua Avenue, Suite 801, Honolulu, HI 96815. The Web site at www.gohawaii.com also provides information.
For information on the economy, write to: Hawaii Department of Business, Economic Development and Tourism, 250 S. Hotel Street, 4th & 5th Floors, Honolulu, HI 96813.
The state's official Web site at www.state.hi.us also provides a gateway to much information on Hawaii's economy, government, and history.



Population. The 2000 United States census reported that Hawaii had 1,211,537 people. The population had increased about 9 percent over the 1990 figure, 1,108,229. According to the 2000 census, Hawaii ranks 42nd in population among the 50 states.

About 72 percent of the people of Hawaii live in the Honolulu metropolitan area—the state's only metropolitan area (see **Metropolitan area**). This area, which consists of the entire island of Oahu, has a population of 876,156. Officially, Honolulu covers all of Oahu. But only the large urban area on the island's southeastern coast is commonly called Honolulu. This urban area has a population of 371,657. Hilo, on the island of Hawaii, is the state's second largest urban area. It is also the largest urban area outside the Honolulu metropolitan area. Hilo has a population of 40,759. Eighteen other urban areas in Hawaii have populations of more than 10,000. Most of these areas are on the island of Oahu. See **Hilo; Honolulu.**

Honolulu resembles large seaport cities in other parts of the United States. The other urban areas of Hawaii serve as trade centers for sugar and pineapple planta-



Artstreet

Modern housing developments, such as the one near Honolulu pictured here, reflect the widespread urban growth in Hawaii. About 72 percent of the state's people live in the Honolulu area.

Population density

Hawaii consists of a chain of 132 islands in the Pacific Ocean. However, nearly all the state's people live on seven islands at the southeastern end of the chain—those shown below, excepting Kaula and Kahoolawe. Nearly three-fourths of Hawaii's people live on the island of Oahu.

WORLD BOOK map, based on U.S. Census Bureau data.

Camera Hawaii

Water sports are a favorite outdoor activity in Hawaii. The people shown on the left are preparing for the start of a canoe race. Other popular water sports on the islands include sailing, scuba diving, surfing, and windsurfing.

tions, or as ports for shipping farm products.

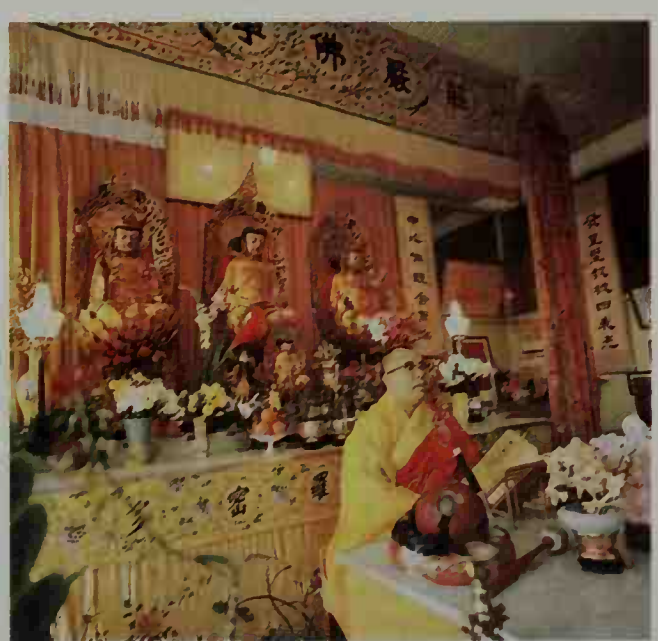
The people of Hawaii are proud that their state is a community of people with many different backgrounds. Many people are mixtures of several nationalities and ethnic groups. The descendants of the Polynesians who first settled in the Hawaiian Islands are called *Hawaiians.* They have bronze-colored skin, large dark eyes, and dark brown or black hair. Only about 7 percent of the people are of chiefly Hawaiian ancestry. About 25 percent are of mainly European ancestry, and about 17 percent are of mainly Japanese descent. Other groups include Filipinos, Chinese, Koreans, and Samoans. More than 20 percent of Hawaii's people belong to two or more ethnic groups.

People of almost every religious group live in Hawaii. Roman Catholics form the state's largest religious group, followed by Shintoist and Buddhist denominations and Mormons. The early Hawaiians practiced a religion that included numerous gods and centered around the worship of various aspects of nature. American and French missionaries converted most of the Hawaiian people to Christianity in the 1820's and 1830's.

Language. Almost all the people of Hawaii speak English. But they frequently use some musical words of the Hawaiian language in their speech. For example, they often refer to a tourist as a *malihini* (newcomer). The Hawaiian alphabet has only 12 letters: A E H I K L M N O P U W. Every Hawaiian word and syllable ends with a vowel. Two consonants never occur without a vowel between them. The accent of most words falls on the next to last syllable.

Some frequently used words in the Hawaiian language include:

ae, *eye,* yes
ai, *AH ee,* eat
akamai, *ah kah MAH ee* or *ah kah MY,* wise; clever
ala, *AH lah,* path; road
aloha, *ah LOH hah,* love; greetings; welcome; fare well
aole, *ah OH lay,* no
hale, *HAH lay,* house
hana, *HAH nah,* work
haole, *HOW lay,* foreigner, especially of Anglo-Saxon ancestry; applied generally to Caucasians
heiau, *HAY ow,* pre-Christian place of worship
hele mai, *HAY lay MY,* come here
hiamoe, *HEE ah MOY,* sleep
hoomalimali, *HO oh MAH lee MAH lee,* flattery
huhu, *hoo HOO,* angry
hula, *HOO lah,*
kai, *KAH ee,* the sea
kamaaina, *KAH mah EYE nah,* "child of the land"; old-timer; people long resident in Hawaii
kane, *KAH neh,* man
kapu, *KAH poo,* forbidden
kaukau, *OW kow,* food
keiki, *KAY kee,* child
ko, *koh,* sugar cane
kokua, *koh KOO uh,* help; cooperation
lani, *LAH nee,* sky; heavenly
lei, *lay,* wreath or garland
luau, *LOO ow,* a feast
mahalo, *mah HAH loh,* thanks
mahimahi, *MAH hee MAH hee,* a delicious fish
maikai, *MY kah ee,* good; handsome; useful
makai, *MAH kah ee* or *mah KY,* at or toward the sea
malihini, *MAH lee HEE nee,* newcomer
manu, *MAH noo,* bird
mauka, *MAH oo kah* or *MOW kuh,* toward the mountains
mauna, *MOW nah,* mountain
mele, *MEH lay* or *MEHL eh,* song; chant
moana, *moh AH nah,* ocean
moopuna, *moh oh POO nah,* grandchild
nani, *NAH nee,* beautiful
nui, *NOO ee,* great; large
oe, *OH ee,* you



Camera Hawaii

A Buddhist monk sits in front of an altar in a Buddhist temple in Honolulu. Many Hawaiians of Asian ancestry are Buddhists who carry on their traditional ways of worship.

ohana, *oh HAH nah,* family
pali, *PAH lee,* cliff
pau, *POW,* finished; done
pehea oe, *pay HAY ah OY,* How are you?
pilikia, *PEE lee KEE ah,* trouble
poi, *POH ee* or *poy,* a food made of taro
pua, *POO ah,* flower
puka, *POO kah,* hole
punee, *POO nay ay,* couch
pupule, *poo POO lay,* crazy
wahine, *wah HEE nay,* woman
wai, *WAH ee,* fresh water
wikiwiki, *WEE kee WEE kee,* to hurry

Clothing. The people of Hawaii wear a great deal of loose, brightly colored clothing. Some of their garments are based on the clothing worn by early Hawaiians. Many Hawaiian fashions spread throughout the United States. For example, the Hawaiian *muumuu* became fashionable during the 1950's. A muumuu is a loose, floor-length dress that was introduced in Hawaii by early missionaries. The missionaries objected to the short skirts that were the only clothing worn by Hawaiian women. The *holomuu* is a fitted version of the muumuu. On formal occasions, women in Hawaii sometimes wear the *holoku,* a holomuu with a train. Another Hawaiian fashion that has become widespread is the *aloha shirt,* a sport shirt with brightly colored tropical or oriental designs.

The islanders often wear *leis* on festive occasions. A lei is a wreath, usually made of flowers strung together. People usually wear leis as necklaces, but sometimes wrap them around their heads or wear them as hatbands. Favorite flowers for leis include carnations, jasmine, orchids, plumeria (frangipani), tuberoses, and white and yellow ginger. Some leis are made by stringing together coral, feathers, nuts, seeds, shells, or ivory from the teeth of sperm whales.

Food. Rice and such fresh fruits as bananas and papayas are basic parts of the islanders' diet. The people enjoy foods from many parts of the world. Restaurants and supermarkets offer many foods eaten by people of various countries. In addition to typical American food, Asian and European foods are popular.

Some people in Hawaii eat *poi,* a starchy food made by pounding the cooked underground stem of the taro plant until it becomes a paste. Islanders also enjoy *laulau,* a package of spinachlike chopped taro leaf, fish, pork, and sometimes chicken, wrapped in ti plant leaves and steamed.

A *luau* (feast) is a popular tourist attraction. It features *kalua pig*—a whole young pig wrapped in leaves and roasted in a pit called an *imu.* Luaus also feature dancing and singing.

Dancing and music. Dancing is the most famous art of the islands. *Hula* means *dance* in Hawaiian. Hula dancers sway their hips and wave their arms gracefully to the rhythm of the music. The dances tell stories and describe the beautiful scenery of the islands. Hawaiians perform other traditional dances accompanied by chants and drums.

Hawaiian music features the ukulele and the Hawaiian steel guitar. The ukulele was developed from a small guitar brought to the islands by Portuguese laborers in the late 1800's. The word *ukulele* means *leaping flea.* The Hawaiian steel guitar was invented by Joseph Kekuku, a Hawaiian musician, about 1895.

Schools. American missionaries set up Hawaii's educational system in the 1820's. In 1840, King Kamehameha III established the public school system of Hawaii.

Artstreet

Schools in Hawaii are attended by children aged 6 through 17. The state Board of Education runs the public schools.

Today, a 13-member Board of Education sets the policies for the state's public school system. One nonvoting student member also serves on the board. The board appoints a superintendent who administers the system through a Department of Education and seven administrative districts. Hawaii has the nation's only statewide, unified public school system.

The children of Hawaii must attend school from the ages of 6 through 17. About 12 percent of the state's grade school and high school students attend private schools. For the number of students and teachers in Hawaii, see **Education** (table).

Libraries. The Library of Hawaii (now the Hawaii State Library) in Honolulu was the first free public library on the islands. It opened in 1913. Today, a statewide public library system serves the islands of Hawaii, Kauai, Lanai, Maui, Molokai, and Oahu.

The Hamilton Library of the University of Hawaii has

James P. Rowan

Polynesian dancers perform at festivals and other events in Hawaii. Polynesians were the original settlers of the islands.

Honfed and Bishop Museum from Camera Hawaii

The Bernice P. Bishop Museum in Honolulu, Hawaii's oldest museum, is a major center for the study of the Pacific Islands.

fine collections of books on the Pacific area and Asia. Important collections of books on Hawaii are also in the Bishop Museum, the Hawaiian Historical Society Library, and the Hawaii State Library.

Museums. The Bernice P. Bishop Museum in Honolulu, established in 1889, is the oldest museum in Hawaii. Scholars there do research on the Pacific Islands, mainly in anthropology, archaeology, botany, entomology, and zoology. Displays include animals, archaeological discoveries, fish, plants, and shells from many islands.

The Honolulu Academy of Arts has exhibits of Western and Asian art. The Mission Houses Museum in Honolulu includes the oldest house in Hawaii, built in 1821. Other museums include the Kauai Museum in Lihue, the Lyman House Memorial Museum in Hilo, the Baldwin Home Missionary Museum in Lahaina, and the Hawaii Maritime Center in Honolulu.

Universities and colleges

This table lists the universities and colleges in Hawaii that grant bachelor's or advanced degrees and are accredited by the Western Association of Schools and Colleges.

Name	Mailing address
Argosy University	Honolulu
Brigham Young University—Hawaii Campus	Laie, Oahu
Chaminade University of Honolulu	Honolulu
Hawaii, University of	*
Hawaii Pacific University	Honolulu

*For campuses, see Hawaii, University of.

Camera Hawaii

The University of Hawaii at Manoa, in Honolulu, excels in the fields of marine biology, Pacific and Asian studies, and tropical agriculture. It is also noted for its courses in geophysics.

Hawaii map index

Metropolitan area

Honolulu 876,156

Counties

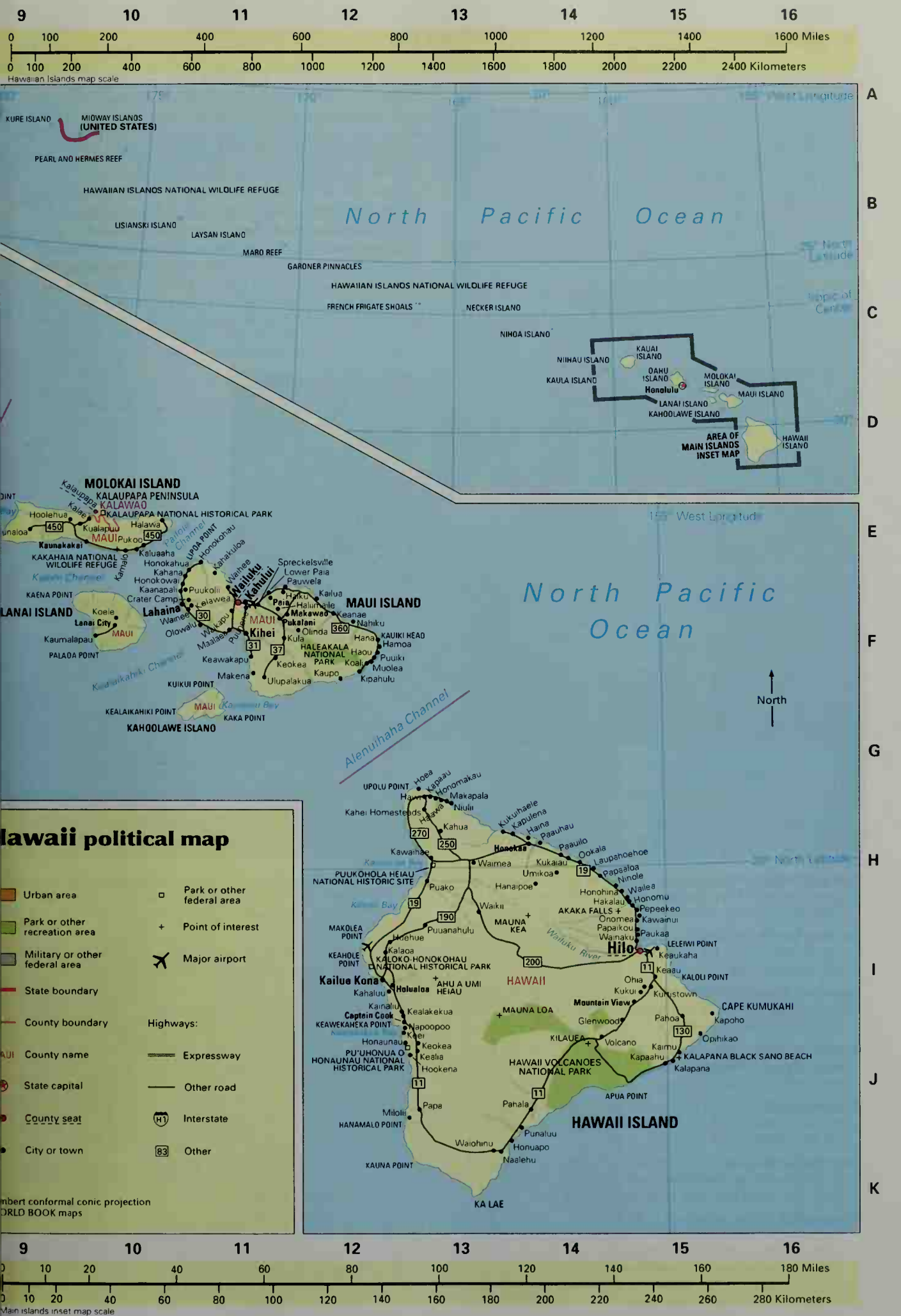
Hawaii .....148,677 ..I 14
Honolulu .....876,156 ..I 4
Kalawao .....147 ..E 10
Kauai .....58,463 ..B 3
Maui .....128,094 ..F 11

Populated places†

Ahuimanu .....8,506 ..I 5
Aiea .....9,019 ..I 5
Anahola .....1,932 ..B 4
Barbers Point Housing .....67 ..J 3
Captain Cook .....3,206 ..I 12
Eleele .....2,040 ..C 3
Ewa .....J 3
Ewa Beach .....14,650 ..J 4
Ewa Gentry* .....4,939 ..J 3
Foster Village .....J 5
Haiku I-Pauwela! .....6,578 ..E 11
Haina .....H 14
Hakalau .....H 14
Halaula* .....495 ..G 13
Halawa* .....13,891 ..J 5
Halawa Heights .....J 5
Haleiwa .....2,225 ..G 3
Haliimaile .....895 ..F 11
Hana .....709 ..F 12
Hanalei .....478 ..C 2
Hanamaulu .....3,272 ..C 4
Hanapepe .....2,153 ..C 3
Hauula .....3,651 ..G 5
Hawaii Kai .....K 7
Hawi .....938 ..G 13
Heeia .....4,944 ..I 6
Hickam Housing .....5,471 ..J 5
Hilo° .....40,759 ..I 15
Holualoa .....6,107 ..I 12
Honalo* .....1,987 ..I 12
Honaunau .....J 12
Honokaa .....2,233 ..H 14
Honokahua .....E 10
Honokowai .....E 10
Honolulu° .....371,657 ..E 7
Honomu .....541 ..H 15
Honouliuli .....J 3
Hoolehua .....E 9
Iroquois Point .....2,462 ..J 4
Kaaawa .....1,324 ..H 5
Kaanapali .....1,375 ..F 10
Kahakuloa .....E 11
Kahaluu .....2,935 ..I 6
Kahana .....H 5
Kahana .....E 10
Kahua .....H 13
Kahuku .....2,097 ..C 7
Kahului .....20,146 ..F 11
Kailua .....36,513 ..D 8
Kailua .....9,870 ..F 12
Kailua Kona .....I 12
Kainaliu .....I 12
Kalae .....E 10
Kalaheo .....3,913 ..C 3
Kalaoa .....6,794 ..I 12
Kalaupapa° .....E 10
Kalihiwai .....717 ..C 2
Kaluaaha .....E 10
Kaneohe .....34,970 ..D 7
Kapaa .....9,472 ..B 4
Kapaau .....1,159 ..G 13
Kaumakani .....607 ..C 3
Kaunakakai .....2,726 ..E 10
Kawaihae .....H 13
Kawailoa .....G 3
Kawailoa Beach .....G 3
Kawainui .....I 15
Kawela Bay* .....410 ..G 3
Keaau .....2,010 ..I 15
Kealakekua .....1,645 ..I 13
Kealia .....B 4
Kealia .....J 13
Keaukaha .....I 15
Keei .....J 13
Kekaha .....3,175 ..C 3
Kelawea .....F 11
Keokea .....F 11
Keokea .....J 13
Keolu Hills .....J 7
Kihei .....16,749 ..F 11
Kilauea .....2,092 ..C 2
Koele .....F 10
Koloa .....1,942 ..C 3
Koloa Landing .....C 3
Kualapuu .....1,936 ..E 10
Kukui .....I 15
Kukuihaele .....317 ..H 13
Kukuiula .....C 3
Kula .....F 11
Kuliouou .....K 7
Kumukumu .....B 4
Kunia .....I 3
Kurtistown .....1,157 ..I 15
Lahaina .....9,118 ..F 10
Laie .....4,585 ..G 5
Lanai City .....3,164 ..F 10
Lanikai .....I 7
Laupahoehoe .....473 ..H 14
Lawai .....1,984 ..C 3
Lihue° .....5,674 ..C 3
Lower Paia .....F 11
Lower Village .....J 3
Maalaea .....454 ..F 11
Maili .....5,943 ..I 2
Makaha .....7,753 ..I 2
Makaha Valley*† .....1,289 ..I 2
Makakilo City .....13,156 ..J 3
Makapala .....G 13
Makawao .....6,327 ..F 11
Maunaloa .....230 ..E 9
Maunalua .....J 7
Maunawili .....4,869 ..J 6
Mililani Town .....28,608 ..I 4
Mokuleia .....1,839 ..G 2
Mountain View .....2,799 ..I 15
Naalehu .....919 ..K 13
Nanakuli .....10,814 ..I 2
Napili-Honokowai* .....6,788 ..E 10
Napoopoo .....J 13
Nawiliwili .....C 4
Niulii .....H 13
Niumalu .....C 4
Numila .....C 3
Olowalu .....F 11
Omao* .....1,221 ..C 3
Ookala .....H 14
Opihikao .....J 15
Paauhau .....H 14
Paauilo .....571 ..H 14
Pacific Palisades .....I 4
Pahala .....1,378 ..J 14
Pahoa .....962 ..J 15
Paia .....2,499 ..F 11
Papaaloa .....H 14
Papaikou .....1,414 ..I 15
Paukaa .....495 ..I 15
Pauwela, see Haiku I-Pauwela!
Pearl City .....30,976 ..I 4
Pepeekeo .....1,697 ..H 15
Pohakapu .....J 6
Poipu .....1,075 ..C 3
Pomoho .....H 3
Princeville* .....1,698 ..C 3
Puhi .....1,186 ..C 3
Pukalani .....7,380 ..F 11
Punaluu .....G 5
Punaluu .....881 ..J 14
Pupukea .....4,250 ..F 3
Puuanahulu .....I 13
Puuiki .....F 12
Puukolii .....F 11
Puunene .....F 11
Schofield Barracks .....14,428 ..H 3
Spreckelsville .....F 11
Sunset Beach .....F 3
Umikoa .....H 13
Village Park* .....9,625 ..I 4
Volcano .....2,231 ..J 14
Wahiawa .....16,151 ..D 7
Waialua .....3,761 ..D 7
Waianae .....10,506 ..I 2
Waihee .....E 11
Waihee-Waiehu* .....7,310 ..F 11
Waikane .....726 ..H 5
Waikapu .....1,115 ..F 11
Wailea .....H 15
Wailua .....2,083 ..B 4
Wailuku° .....12,296 ..F 11
Waimalu .....29,371 ..J 4
Waimanalo .....3,664 ..J 7
Waimanalo Beach .....4,271 ..J 7
Waimea .....7,028 ..H 13
Waimea .....1,787 ..C 3
Waimea .....G 3
Wainaku .....1,227 ..I 15
Wainee .....F 10
Wainiha .....C 2
Waiohinu .....K 13
Waipahu .....33,108 ..I 4
Waipio* .....11,672 ..I 4
Waipio Acres .....5,298 ..I 4
Wheeler AFB .....2,829 ..I 3
Whitmore Village .....4,057 ..H 4

*Does not appear on map; key shows general location.
†Places with populations are census designated places, which are unincorporated, but recognized as significant settled communities by the U.S. Census Bureau.
°County seat.
Places without population figures are smaller communities.
Source: 2000 census.

North Pacific Ocean
Islands west of Kaula Island are part of Honolulu county.
LEHUA ISLAND
NIIHAU ISLAND
KAULA ISLAND
KAUAI ISLAND
Kauai Channel
Kaulakahi Channel
HULEIA NATIONAL WILDLIFE REFUGE
MENEHUNE FISH POND
SPOUTING HORN
Kapaa
Lihue
Waimea
Kekaha
Hanapepe
Port Allen
Kekaha
Puuwai
PUEO POINT
KAWAIHOA POINT
KAHUKU POINT
OAHU ISLAND
HONOLULU
Waialua
Wahiawa
Kaneohe
Kailua
Pearl Harbor
AREA OF OAHU ISLAND INSET MAP
KOKO HEAD
Honolulu
KAENA POINT
Kauai Channel
KAHUKU POINT
Kawela
Paumalu
Sunset Beach
Pupukea
Waimea
Kahuku
MOKUAUIA ISLAND
Laie Bay
Laie
POLYNESIAN CULTURAL CENTER
Hauula
Kawailoa Beach
Kawailoa
Kamananui Stream
Waialua Bay
Kaiaka Bay
Anahulu River
Haleiwa
Mokuleia
Waialua
Kamooloa
Punaluu
Kahana Bay
Kahana
Kaaawa
OAHU ISLAND
Kukonahua Stream
Pomoho
Whitmore Village
Wahiawa Reservoir
SCHOFIELD BARRACKS MILITARY RESERVATION
Schofield Barracks
Wahiawa
WHEELER AIR FORCE BASE
Waipio Acres
Waikane
KUALOA POINT
Kaalaea
KAPAPA ISLAND
MOKUMANU ISLANDS
KANEOHE BAY MARINE CORPS AIR STATION
MOKAPU POINT
MOKAPU PENINSULA
Kahaluu
Ahuimanu
Heeia
Kaneohe Bay
Kaneohe
Kailua
Lanikai
MOKULUA ISLANDS
Keolu Hills
Maunawili
Waimanalo
Waimanalo Beach
MANANA ISLAND
MAKAPUU PO
Makaha
KEPUHI POINT
Waianae Homesteads
Waianae
NAVAL RESERVATION
Mililani Town
HONOLULU
Waiawa Stream
Maili
MAILI POINT
Lualualei
Nanakuli
Pacific Palisades
Pearl City
Waipahu
Aiea
Halawa Stream
CAMP H. M. SMITH
Halawa Heights
TRIPLER ARMY HOSPITAL
Waimalu
USS ARIZONA NATIONAL MEMORIAL
Honolulu
Lower Village
Pearl Harbor
PEARL HARBOR NAVAL BASE
Foster Village
FORT SHAFTER MILITARY RESERVATION
Makakilo City
Ewa
HICKAM AIR FORCE BASE
Hickam Housing
ALIAMA TOWER
ROYAL MAUSOLEUM
Barbers Point Housing
Iroquois Point
Ewa Beach
CAMPBELL INDUSTRIAL PARK
BARBERS POINT NAVAL AIR STATION
KAMEHAMEHA MILITARY RESERVATION
FORT HONOLULU
INTL. AIRPORT
PUNCHBOWL NATIONAL MEMORIAL CEMETERY OF THE PACIFIC
Honolulu
BARBERS POINT
WAIKIKI BEACH
KAPIOLANI PARK
DIAMOND HEAD
KUPIKIPIKIO POINT
Maunalua
Kuliouou
Hawaii Kai
KOKO HEAD
North Pacific Ocean
0 2.5 5 10 15 20 25 30 35 40 Miles
0 2.5 5 10 15 20 25 30 35 40 45 50 55 60 Kilometers
Oahu Island inset map scale


9 10 11 12 13 14 15 16
0 100 200 400 600 800 1000 1200 1400 1600 Miles
0 100 200 400 600 800 1000 1200 1400 1600 1800 2000 2200 2400 Kilometers
Hawaiian Islands map scale
A
B
C
D
E
F
G
H
I
J
K
KURE ISLAND
MIDWAY ISLANDS (UNITED STATES)
PEARL AND HERMES REEF
HAWAIIAN ISLANDS NATIONAL WILDLIFE REFUGE
LISIANSKI ISLAND
LAYSAN ISLAND
MARO REEF
GARDNER PINNACLES
HAWAIIAN ISLANDS NATIONAL WILDLIFE REFUGE
FRENCH FRIGATE SHOALS
NECKER ISLAND
NIHOA ISLAND
North Pacific Ocean
NIIHAU ISLAND
KAUAI ISLAND
OAHU ISLAND
Honolulu
KAULA ISLAND
MOLOKAI ISLAND
MAUI ISLAND
LANAI ISLAND
KAHOOLAWE ISLAND
AREA OF MAIN ISLANDS INSET MAP
HAWAII ISLAND
MOLOKAI ISLAND
KALAUPAPA PENINSULA
KALAWAO
KALAUPAPA NATIONAL HISTORICAL PARK
Hoolehua
Kualapuu
MAUI
Pukoo
Halawa
Kaunakakai
KAKAHAIA NATIONAL WILDLIFE REFUGE
Kaluaaha
Honokahua
Kahana
Honokowai
Kaanapali
Puukolii
Crater Camp
Kelawea
Lahaina
Waiehu
Waihee
Spreckelsville
Lower Paia
Pauwela
Nailiuku
Kahului
Paia
Haiku
Halimaile
Makawao
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Kaupo
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Nahiku
Hana
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Puuiki
Muolea
KAUIKI HEAD
HALEAKALA NATIONAL PARK
Haou
Koali
Kaupo
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KUIKUI POINT
KEALAIKAHIKI POINT
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Kurtistown
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Kainaliu
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Captain Cook
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Kalapana
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Milolii
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Punaluu
Waiohinu
Honuapo
Naalehu
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KA LAE
Hawaii political map
Urban area
Park or other recreation area
Military or other federal area
State boundary
County boundary
County name
State capital
County seat
City or town
Park or other federal area
Point of interest
Major airport
Highways:
Expressway
Other road
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Main islands inset map scale

Hawaii's mild climate and beautiful scenery make the state one of the favorite year-round playgrounds of the world. Several million vacationers visit the islands each year. Many visitors remain in Honolulu to enjoy Waikiki Beach and other attractions on Oahu. Others prefer the less populated islands. Tourists find excellent hotels on Hawaii, Kauai, Lanai, Maui, Molokai, and Oahu. Wherever they go, vacationers are likely to attend a luau, featuring delicious Hawaiian food and the hula.

Temperatures of the air and water seldom differ more than a few degrees in Hawaii. The state's mild temperatures add to the enjoyment of swimming and boating. Water temperatures at Waikiki Beach average 75 to 77 °F (24 to 25 °C) in March and 77 to 82 °F (25 to 28 °C) in August. Swimmers at Waikiki Beach ride the long, rolling waves on surfboards. Vacationers catch game fish in the deep waters between the islands. In winter, a few skiers race down Mauna Kea on Hawaii Island.

Hawaii's many celebrations and festivals attract thousands of tourists every year. One of the major events is Aloha Week Festivals, held from mid-September through mid-October on the islands of Hawaii, Kauai, Maui, Molokai, and Oahu. The islands offer feasts, folk and street dancing, and parades.

Joe Solem, Camera Hawaii

Parade during an Aloha Week festival

Places to visit

Akaka Falls, near Hilo on Hawaii Island, is a long, slender waterfall on Kolekole stream. The falls plunge over a 442-foot (135-meter) cliff into a wooded gorge.

Aloha Tower, in Honolulu, rises above the piers where passenger ships dock. From the top, visitors have a fine view of Honolulu and its harbor. The tower has shops and restaurants.

Barking Sands, on Kauai, is a beach that is sometimes quite dry. At these times, the sand, when walked on, makes a sound like a barking dog.

Hamakua Coast lies between Hilo and Honokaa on Hawaii Island. A highway winds through pasture and other agricultural lands and around Mauna Kea, Hawaii's highest mountain.

Kapiolani Park extends from Waikiki to Diamond Head, an extinct volcano in Honolulu. The park offers concerts and pageants and has a zoo.

Kealakekua Bay, on the west coast of Hawaii Island, is the site where Captain James Cook was killed in 1779. A monument at the bay honors Cook.

Menehune Fishpond, near Lihue Kauai, was supposedly built by the *Menehune,* dwarflike characters of the Hawaiian Islands. The pond has walls of cut stone.

Nuuanu Pali, at the upper end of Nuuanu Valley on Oahu, offers a magnificent view of the northeastern coast from a cliff 1,186 feet (361 meters) high. A highway leads to the top of the cliff. King Kamehameha I drove some of Oahu's defenders over this cliff when he conquered the island in 1795.

Pearl Harbor, on Oahu, is a huge natural harbor used as a U.S. naval base. The battleship *Arizona,* sunk in the Japanese attack of Dec. 7, 1941, rests on the harbor bottom. See **Pearl Harbor.**

Polynesian Cultural Center, in Laie on Oahu, includes seven villages representing the people of Fiji, Hawaii, Marquesas Islands, New Zealand, the Samoa Islands, Tahiti, and Tonga.

Sea Life Park, at Makapuu Point on Oahu, is a scientific and recreational oceanarium with performing porpoises and whales.

Waimea Canyon, on Kauai, has a beautifully colored gorge 3,400 feet (1,036 meters) deep. It can be viewed from several lookouts along a highway.

National parklands. Hawaii has two national parks—Haleakala National Park on Maui, and Hawaii Volcanoes National Park on Hawaii Island. The Pu'uhonua o Honaunau National Historical Park on Hawaii Island shows the history of the Polynesian people. Other parklands include the Puukohola Heiau National Historic Site and the Kaloko-Honokohau National Historic Park, both on Hawaii Island. The Kalaupapa National Historical Park is on Molokai. See **Haleakala National Park; Hawaii Volcanoes National Park.**

State parks. Hawaii established its park system in 1949, 10 years before achieving statehood. The state now has 68 state park and historic site areas. For information, write to Director, Department of Land and Natural Resources, State of Hawaii, 1151 Punchbowl Street, Honolulu, HI 96813.

Annual events

January-March
Hula Bowl college all-star football game on Maui (January); Narcissus Festival in Honolulu (January); NFL Pro Bowl (February); Cherry Blossom Festival in Honolulu (February).

April-June
Merrie Monarch Festival in Hilo (April); Lei Day, statewide (May 1); 50th State Fair on Oahu (May-June); Miss Hawaii Scholarship Pageant in Honolulu (June); King Kamehameha celebration, statewide (June).

July-September
Makawao Rodeo on Maui (July); Japanese Bon Dances at Buddhist centers (weekends during July and August); Hawaiian International Billfish Tournament on Hawaii Island (August); Keiki Hula Festival in Honolulu (August); Hawaii County Fair in Hilo (September).

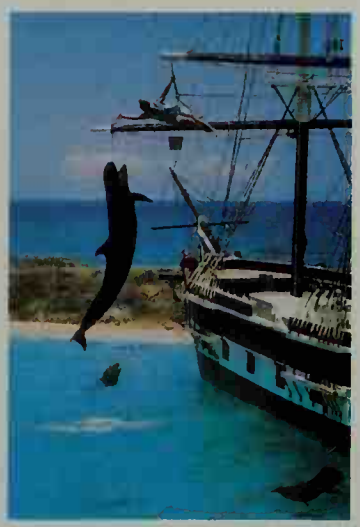
October-December
Orchid Plant and Flower Show in Honolulu (October); Kona Coffee Festival on Hawaii Island (November); Hawaiian Pro Surfing on the North Shore of Oahu (November or December); Honolulu Marathon in Honolulu (December).

Werner Stoy, Camera Hawaii

Colorful Waimea Canyon, on Kauai

© Mark Stephenson, West Light

Haleakala crater, a dormant volcano in Haleakala National Park, on Maui



Camera Hawaii

Performing whales at Sea Life Park

Artstreet

Reconstructed village at the Polynesian Cultural Center, Oahu

Hawaii is made up of 132 islands. The islands extend northwest for 1,523 miles (2,451 kilometers), about the distance between New York City and Denver. Geographers divide the islands into three groups: (1) eight main islands in the southeast, (2) islets of rock in the middle, and (3) coral and sand islands in the northwest. All the islands were formed by volcanoes built up from the ocean floor. The volcanoes northwest of the eight main islands are submerged and worn away by waves and ocean currents. Only atolls and pieces of volcanic rock still remain above the water (see **Atoll**). These 124 minor islands have a combined area of only 3 square miles (8 square kilometers).

The total general coastline of the eight main islands is 750 miles (1,207 kilometers) long. The tidal shoreline, including bays, islets, and river mouths, is 1,052 miles (1,693 kilometers) long. Rough, black rocks of lava jut out of the water along some of the coasts. In many places, tall cliffs rise almost straight up from the water's edge. Most of the islands have white sand beaches. Black sand, which formed when molten lava flowed into the ocean, covers other beaches.

Thick growths of tropical plants and trees thrive in the areas of rich soil where rainfall is heavy. Many of the native plants are found nowhere else in the world. Many types are rare and in danger of extinction. Most plants commonly seen in Hawaii have been imported, including bougainvillea, oleanders, and orchids. Hawaii has little native wildlife, and most of the animals are rare. Scientists take special interest in the brightly colored forest birds and tiny land snails. A wide variety of seabirds live along the island shores. Many kinds of fish, including tropical fish, are found in the waters around the islands.

People live on seven of the eight main islands. Kahoolawe has no permanent residents. The 124 minor islands are too infertile and small to support human life. Midway Island, in the far northwestern part of the Hawaiian group of islands, is not a part of the state. It is controlled by the U.S. Department of the Interior. The eight main islands, from east to west, are Hawaii, Maui, Kahoolawe, Molokai, Lanai, Oahu, Kauai, and Niihau.

Hawaii, often called the *Big Island,* is the largest island in the state. It covers 4,038 square miles (10,458 square kilometers). The island was formed by five volcanoes: Kohala in the north, Hualalai in the west, Mauna Kea and Mauna Loa near the center, and Kilauea on the southeastern slope of Mauna Loa. Mauna Kea (13,796 feet, or 4,205 meters) and Mauna Loa (13,677 feet, or 4,169 meters) are the highest points in the state.

Mauna Loa and Kilauea are Hawaii's only active volcanoes. Mauna Loa erupts at irregular times, and sometimes sends streams of fiery lava flowing down to the ocean. Kilauea erupts more often. Lava from this volcano has swept over farmland and destroyed residences and other property. A highway passes near the crater's edge, and people often refer to the mountain as a "drive-in volcano." Visitors can view the erupting volcano from the shoreline at the base of the mountain. The spectacle of the eruption and its flow of lava attracts thousands of visitors each year. Scientists of the U.S. Geological Survey study volcanic activity at the Hawaiian Volcano Observatory on the rim of Kilauea.

The island's northeastern and southeastern coasts are rimmed by cliffs. Here and there, waterfalls plunge over the cliffs to the ocean below. On the island's western side are coffee farms and cattle ranches. Hilo, the largest city, lies in the northeast. It is the island's chief port and the seat of Hawaii County.

Maui *(MOW ee)* is often called the *Valley Island.* Many canyons cut into the two volcanic mountains that form the island. Between the mountains is a broad, low isthmus with sugar cane plantations. The highest point on Maui is 10,023-foot (3,055-meter) Haleakala, which has the largest dormant volcanic crater in the world. The crater measures about 20 miles (32 kilometers) around and is 3,000 feet (914 meters) deep. The largest city on Maui is Kahului. Wailuku is the seat of Maui County.

Kahoolawe *(kah HOH uh LAH way)* is the smallest of the main islands. It is dry and windswept, and no one lives there. From 1945 to 1990, the U.S. Army, Navy, and Air Force used the island for target practice. The island is being developed as a cultural reserve.

Molokai *(MOH loh KAH ee)* is called the *Friendly Island* because of the courtesy its people show to guests.

Werner Stoy, Camera Hawaii

Rugged cliffs and deep valleys cover most of the eastern part of Molokai. Crops are raised on the fertile plain that covers the western and central parts of the island.

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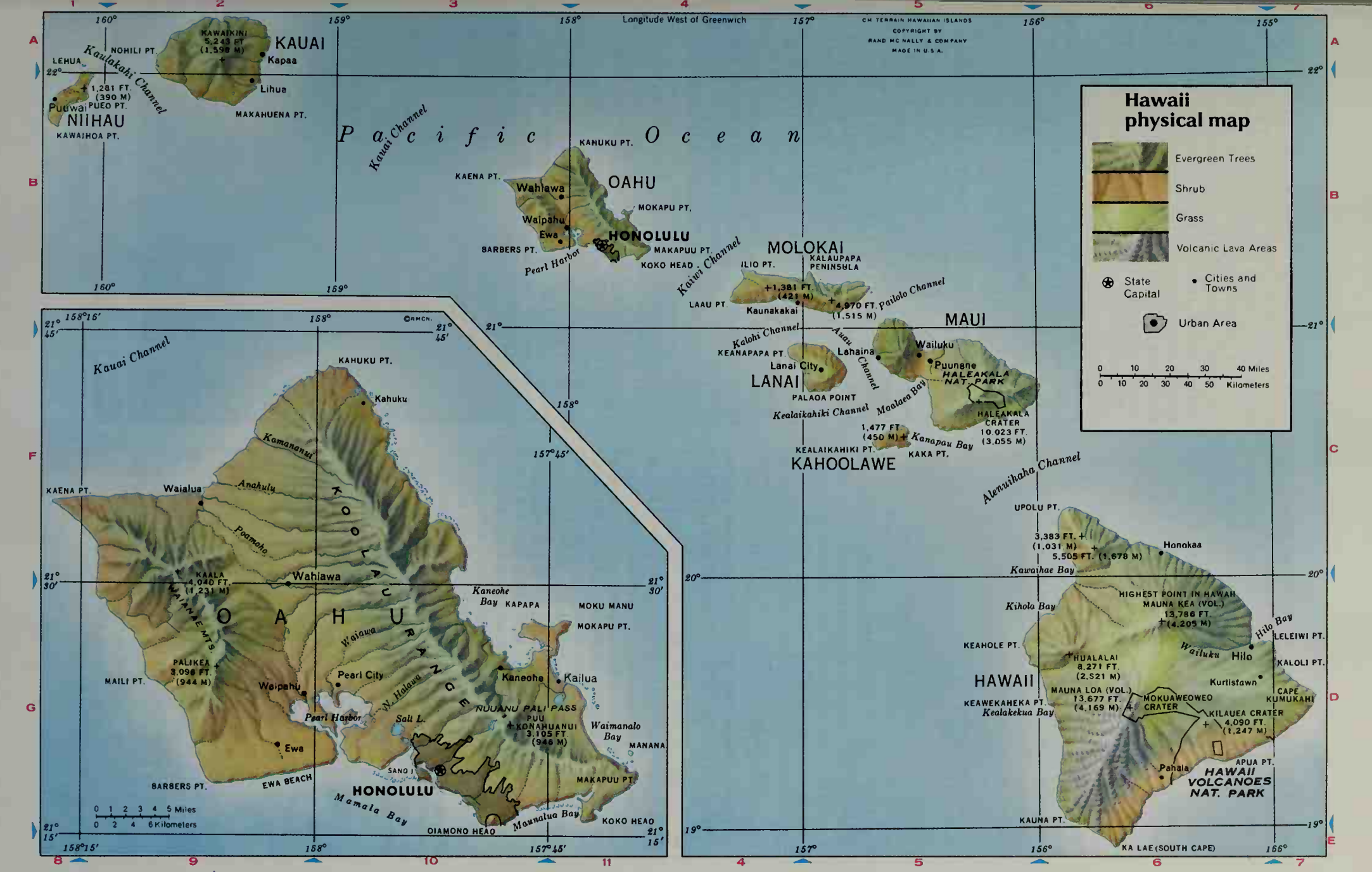

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The island has three regions. Western Molokai is a broad, dry plateau covered mostly by cattle ranches. The eastern region consists of rugged mountains and deep canyons. The central region is a fertile plain where various crops are grown. Molokai is the site of a famous colony for victims of leprosy (Hansen's disease). On Makanalua, or Kalaupapa, Peninsula is the colony where Father Joseph Damien de Veuster worked (see **Damien de Veuster, Joseph**). Kaunakakai is the port on Molokai. Kalaupapa is the seat of Kalawao county.

Lanai *(lah NAH ee)* is a resort island. The maker of Dole pineapple products once owned 98 percent of the island and operated a pineapple plantation there. Dole's land now belongs to Castle & Cooke, Inc., which has developed the island as a resort area. The rest of the island is owned by the state of Hawaii.

Oahu *(oh AH hoo)* is the center of life in Hawaii. Known as the *Gathering Place,* it is the home of about 80 percent of the state's people. The island consists of two mountain ranges separated by a wide valley. The Koolau Range forms the island's eastern side, and the Waianae Range forms the western side. The valley between these ranges is a rolling, fertile plain with pineapple and sugar cane plantations.

Average monthly weather

Honolulu

	Temperatures F° High	Low	Temperatures C° High	Low	Days of rain or snow
Jan.	77	67	25	19	12
Feb.	77	67	25	19	12
Mar.	77	68	25	20	13
Apr.	78	69	26	21	12
May	80	71	27	22	11
June	81	72	27	22	11
July	82	74	28	23	13
Aug.	83	74	28	23	13
Sept.	83	74	28	23	12
Oct.	82	73	28	23	13
Nov.	80	71	27	22	13
Dec.	78	69	26	21	14

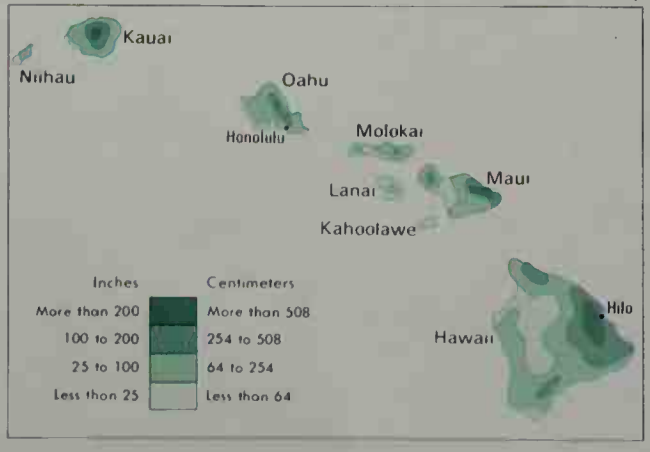
Hilo

	Temperatures F° High	Low	Temperatures C° High	Low	Days of rain or snow
Jan.	78	62	26	17	20
Feb.	79	62	26	17	19
Mar.	79	63	26	17	24
Apr.	79	64	26	18	25
May	81	65	27	18	25
June	83	66	28	19	24
July	83	67	28	19	27
Aug.	83	68	28	20	27
Sept.	83	68	28	20	23
Oct.	82	67	28	19	24
Nov.	80	66	27	19	23
Dec.	79	64	26	18	24

Average yearly precipitation

Precipitation varies enormously throughout Hawaii. Rainfall on the mountaintops may exceed 200 inches (508 centimeters). The lowlands may receive less than 25 inches (64 centimeters).

WORLD BOOK map



Pearl Harbor, one of the largest natural harbors in the Pacific Ocean, is on Oahu's southern coast. This coral-free harbor has about 10 square miles (26 square kilometers) of navigable water behind a narrow entrance. The United States Pacific Fleet has headquarters there. On Dec. 7, 1941, a surprise attack on the naval base by Japanese warplanes caused the United States to enter World War II. Honolulu, the state capital and largest urban area, lies east of Pearl Harbor.

Kauai *(KOW eye,* or *KAH oo AH ee)* is called the *Garden Island* because of its rich greenery and beautiful gardens. The island looks like a circle, with 5,243-foot (1,598-meter) Kawaikini Peak in the center. Nearby is 5,080-foot (1,548-meter) Mount Waialeale, the world's rainiest spot. It has an average annual rainfall of 460 inches (1,170 centimeters). Dozens of streams flow from this rainy area to the sea through deep canyons, which have been worn into the volcanic rock that forms the island. One of these canyons, Waimea, has colorful rock walls 2,857 feet (871 meters) high. They look much like the rock formations in the Grand Canyon of Arizona. The rugged Na Pali (cliffs) on the northwestern coast make it impossible to build a road entirely around the island. Kapaa is the largest city. Lihue is the seat of Kauai County.

Niihau *(NEE ee HAH oo)* is known as the *Forbidden Island.* No one can visit it without the owners' permission. Elizabeth Sinclair bought most of the island from King Kamehameha V in 1864 for $10,000. She had been returning to New Zealand from British Columbia, but Kamehameha persuaded her to remain in Hawaii. The Robinson family, descendants of Sinclair's, still owns the island. The family runs a cattle ranch that almost covers the island.

Niihau is one of the few places where the people still usually speak the Hawaiian language. Low plains at each end of the island rise to a plateau in the center. Puuwai is the largest village.

Climate. Cool trade winds keep Hawaii's climate mild all year. There is little difference in temperature between night and day, or between summer and winter. Temperatures in the lowlands average about 77 °F (25 °C) in July and 71 °F (22 °C) in January.

The highest temperature in Hawaii, 100 °F (38 °C), was recorded at Pahala on April 27, 1931. The lowest temperature was 12 °F (−11 °C), at Mauna Kea on May 17, 1979.

Rainfall varies from over 400 inches (1,020 centimeters) a year on some of the mountaintops to less than 10 inches (25 centimeters) in the lowlands. The heaviest rains generally fall on the northeastern sides of the islands. Snow sometimes covers the highest points on Hawaii and Maui.

Major islands

Island	Length In mi	Length In km	Width In mi	Width In km	Area In mi²	Area In km²
Hawaii	93	(150)	76	(122)	4,038	(10,458)
Kahoolawe	11	(18)	6	(10)	45	(117)
Kauai	33	(53)	25	(40)	553	(1,432)
Lanai	18	(29)	13	(21)	140	(363)
Maui	48	(77)	26	(42)	729	(1,888)
Molokai	38	(61)	10	(16)	261	(676)
Niihau	18	(29)	6	(10)	73	(189)
Oahu	44	(71)	30	(48)	608	(1,575)

Hawaii's economy once relied chiefly on sugar cane and pineapple. Today, service industries provide the vast majority of Hawaii's *gross state product*—the total value of goods and services produced in a state in a year. Much of the growth in service industries has resulted from an increase in tourism. About 7 million tourists visit Hawaii each year, contributing about $11 billion to the state's economy. The islands of Oahu and Maui draw the most visitors. Most visitors come from other states of the United States, from Canada, or from Asian nations. Heavy tourist spending benefits such service establishments as hotels, restaurants, and shops.

Military activities also contribute much to the state's economy. Hawaii's strategic location between Asia and the Americas has caused the federal government to maintain strong U.S. military bases and satellite tracking facilities in the state.

Natural resources. Plants thrive in Hawaii's mild, warm climate. Deep deposits of topsoil lie in the valleys between mountains. Rain seeps into the upland rocks and provides large reserves of underground water. Hawaii has few minerals. Kauai and Maui have soils rich in titanium oxide, a paint pigment.

Service industries, as a group, account for about 90 percent of Hawaii's gross state product. No other state depends so heavily on income from the service sector.

Finance, insurance, and real estate make up Hawaii's leading service industry in terms of the gross state product. The construction of new hotels serves the vibrant tourist trade. The state's largest banking company, Bank of Hawaii, is based in Honolulu, on Oahu.

Ranked next among Hawaii's service industries are (1) community, business, and personal services and (2) government. Each of these groups contributes an equal amount to the gross state product.

Community, business, and personal services include private health care; law, accounting, and engineering firms; hotels; and rental car agencies. Many resort hotels line Hawaii's beaches. The fast-growing health services field now employs about the same number of workers as do hotels, long a leading employer in the state. High technology plays an important part in Hawaii's business services. A number of high-technology parks, where firms engage in such activities as developing computer software, benefit this industry group.

Production and workers by economic activities

Economic activities	Percent of GSP* produced	Employed workers: Number of people	Employed workers: Percent of total
Finance, insurance, & real estate	23	61,000	8
Community, business, & personal services	22	238,300	32
Government	22	166,300	22
Wholesale & retail trade	16	161,500	22
Transportation, communication, & utilities	10	46,200	6
Construction	4	30,500	4
Manufacturing	3	19,800	3
Agriculture	1	22,100	3
Total	100	746,200	100

*GSP = gross state product, the total value of goods and services produced in a year. Figures are for 1998.
Sources: *World Book* estimates based on data from U.S. Bureau of Economic Analysis and U.S. Bureau of Labor Statistics.

Government services include the operation of public schools, hospitals, and military facilities. The U.S. Army, Air Force, Navy, and Marines all operate bases on Oahu. These bases employ both military and civilian workers.

Wholesale and retail trade form the state's fourth-ranking service industry. Wholesale trade, which includes foreign trade, takes place when a buyer purchases goods directly from a producer. The goods may then be sold to other businesses for resale to consumers. The wholesale trade of groceries and petroleum products is important in Hawaii. Retail trade involves selling products to the final consumer. Restaurants and grocery stores are the leading retail establishments in Hawaii.

Transportation, communication, and utilities rank fifth among service industries in Hawaii. Honolulu is the home of Alexander & Baldwin, owner of Matson Navigation Company, one of the nation's largest shipping firms. More information about transportation and communication can be found later in this section.

Manufacturing. Goods manufactured in Hawaii have a *value added by manufacture* of about $1 $\frac{1}{4}$ billion a year. This figure represents the increase in value of raw materials after they become finished products.

Food processing is Hawaii's leading manufacturing activity in terms of value added by manufacture. Refined sugar and canned pineapple are among the state's most valuable food products. Bread, candy, dairy products, juices, and soft drinks are also produced in the state.

Other important products manufactured in Hawaii include printed materials; refined petroleum; stone, clay, and glass products; jewelry; and clothing. Newspapers are the most valuable type of printed materials. Refineries on Oahu process petroleum.

Agriculture. All the main islands of Hawaii except Kahoolawe have some kind of agriculture. Farmland covers about 35 percent of Hawaii. Most of the farmland is

© Greg Vaughn, Tom Stack & Associates

Resort hotels, which line the beaches of Hawaii, provide employment for many workers. The state's warm, mild climate attracts vacationers at all times of the year.

occupied by ranches and by plantations owned by large corporations. The state has about 5,500 farms.

Crops provide about 85 percent of Hawaii's farm income. Sugar cane and pineapples are the most valuable crops. They account for nearly 40 percent of the state's income from agriculture. The island of Maui produces most of the sugar cane and most of the pineapples.

Hawaii exports large amounts of flowers and leis. Hilo is the center of the orchid-growing and flower-packaging industry. Coffee grows on small farms on each of the five largest islands. Several islands grow macadamia nuts and package them for sale. Avocados, bananas, guavas, papayas, and other fruits thrive in Hawaii. Small truck farms raise many vegetables for local use, including beans, corn, lettuce, potatoes, tomatoes, and taro.

Livestock and livestock products contribute about 15 percent of the farm income. The island of Hawaii has several large cattle ranches. Dairy and egg farms are a major source of farm income on Oahu. Maui and Kauai raise cattle and hogs.

Fishing industry in Hawaii produces an annual fish catch of about $65 million. The most important commercial fish are the swordfish and the bigeye, a type of tuna.

Aquaculture, the commercial raising of animals and plants that live in water, is a growing industry in Hawaii. Annual aquaculture production exceeds $16 million. Algae and shellfish are leading products.

Electric power. Electric power plants that burn petroleum supply almost all of the electric power used in Hawaii. A small amount of the state's power comes from alternative sources, such as geothermal, hydroelectric, or solid waste-burning plants.

Transportation to and from Hawaii is by air and sea. Because the state has little industry, most goods must be shipped by vessel or air cargo from the United States mainland or from foreign countries. This makes some items more expensive than on the mainland.

Hawaiian airports have heavy passenger traffic because Hawaii is a major tourist destination and because flying is the quickest and easiest way of traveling from one island to another, even for local people. The state's chief airports are Honolulu, Kahului on Maui, Lihue on Kauai, and Kona and Hilo on the island of Hawaii. Airlines link Hawaii to the mainland United States and Canada, and to eastern Asia, Australia, and other places.

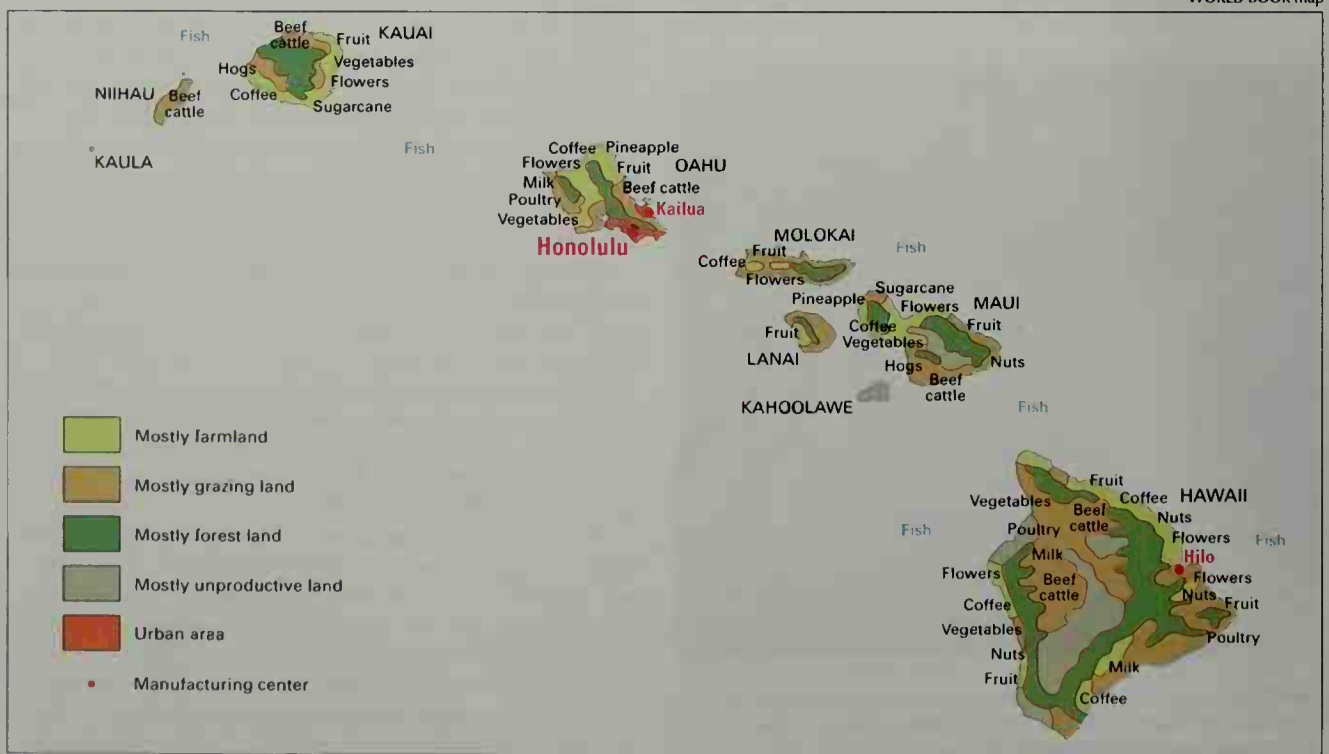
Ships bring most of the food, manufactured products, and raw materials used in Hawaii. The chief ports of the islands include Honolulu and Barbers Point on Oahu, Hilo and Kawaihae on Hawaii, Nawiliwili on Kauai, Kahului on Maui, and Kaunakakai on Molokai. The main islands have about 4,200 miles (6,760 kilometers) of roads and highways. Trucks haul most of the agricultural produce and freight in Hawaii.

Communication. Hawaii's first English-language newspaper, the *Sandwich Island Gazette and Journal of Commerce,* began publication in Honolulu in 1836. The islands have about 20 newspapers today, including 6 daily papers. *The Honolulu Advertiser* and the *Honolulu Star-Bulletin* have the greatest daily circulations. Most of the newspapers are printed in English, but four dailies are in Chinese, Japanese, or Korean. The state's publishers also print about 35 periodicals.

The state's first two radio stations, KDYX and KGU, began broadcasting in Honolulu in 1922. KGMB-TV, the first television station, opened in Honolulu in 1952. Hawaii has about 63 radio stations and 20 television stations. Cable TV systems and Internet providers serve many of Hawaii's communities.

Economy of Hawaii This map shows the economic uses of land in Hawaii and where the state's leading farm products are produced. The major urban areas, shown on the map in red, are the state's most important manufacturing and service centers.

WORLD BOOK map



Constitution. The Constitution of Hawaii went into effect in 1959, when Hawaii became the 50th state. The Constitution had been approved in 1950, when the islands were still a territory.

Amendments to the Constitution may be proposed by the legislature or by a constitutional convention. To be approved by the legislature, an amendment must receive a two-thirds vote in one session, or a majority vote in two successive sessions. Voters must approve a constitutional convention before it can meet. They must vote on holding a constitutional convention at least every 10 years.

All amendments to the Constitution must be approved by the voters during elections. In a general election, at least 50 percent of those voting in the election must approve the amendment. In a special election, an amendment must be approved by at least 30 percent of the registered voters.

Executive. The governor and lieutenant governor of Hawaii are the only elected top state officials. They are elected to four-year terms.

The governor appoints the heads of state departments, including the attorney general, comptroller, and finance director. The governor also appoints judges of high courts and other officials. The state Senate must approve these selections. The governor can also veto legislation, but the legislature can reject the veto by a two-thirds majority vote in both houses.

Legislature consists of a 25-member Senate and a 51-member House of Representatives. Senators are elected from 25 senatorial districts, and serve four-year terms. Representatives are elected from 51 districts, and serve two-year terms.

Hawaii's Constitution specifies the number of senators and representatives. It also provides for a commission to *reapportion* (redivide) legislative districts if necessary. The commission meets every 10 years to determine if the state's legislative districts, and also its congressional districts, must be changed.

In 1965, a federal court ordered Hawaii to redraw its senatorial districts to provide equal representation. The legislature set up senatorial districts based on the number of registered voters. But in 1982, a federal court ordered Hawaii to redraw the senatorial districts based on resident population.

The Hawaii legislature meets every year on the third Wednesday in January. Legislative sessions last 60 working days. Special sessions are limited to 30 days.

Courts. The Supreme Court is the highest appeals court in Hawaii. It has a chief justice and four associate justices. Hawaii also has an intermediate court of appeals, which has a chief judge and two associate judges. Hawaii's highest trial courts are four circuit courts. The governor appoints members of the Supreme Court, the intermediate court of appeals, and the circuit courts to 10-year terms. The appointed judges are selected from lists of names provided by a judicial selection commission. Other courts include four district courts, a tax appeals court, a land registration court, and a family court.

Local government. All of Hawaii's populated places are governed as part of the county in which they are located. There are no self-governing, incorporated cities, towns, or villages in the state. For example, Honolulu is officially known as the City and County of Honolulu. It is one governmental unit, and it consists of Oahu and all other islands in the state that are not in any other county. Honolulu is governed by a mayor and nine council members. All of these officials are elected to four-year terms.

The governors of Hawaii

	Party	Term
William F. Quinn	Republican	1959-1962
John A. Burns	Democratic	1962-1974
George R. Ariyoshi	Democratic	1974-1986
John Waihee	Democratic	1986-1994
Ben Cayetano	Democratic	1994-

Hawaii has four counties—Hawaii, Honolulu, Kauai, and Maui. Kalawao is a part of the city and county of Honolulu and consists of the part of Molokai Island that is occupied by a settlement of present and former leprosy patients. The state department of health manages this area. Hawaii, Kauai, and Maui counties, and the city and county of Honolulu are governed by mayors and elected county councils.

Revenue. Taxation provides about 55 percent of the state government's *general revenue* (income). Most of the rest comes from federal grants and from charges for government services. The largest single source of state government revenue is a general excise tax, imposed on nearly all businesses. Unlike most states, Hawaii does not require retail businesses to collect the tax from customers. However, most businesses in Hawaii include the tax in their prices. A personal income tax is the second largest source of revenue. Other sources include taxes on public utilities and on financial institutions.

Politics. Until the mid-1950's, Republican candidates usually won office in Hawaii elections. The Democrats then began gaining strength. After Hawaii became a state in 1959, the voters elected Governor William F. Quinn, a Republican. Republicans controlled the Senate, and Democrats the House. In 1962, Democrat John A. Burns became governor and his party won control of both houses of the legislature. Since then, Democrats have held the governorship and have controlled Hawaii's legislature. For Hawaii's electoral votes and voting record in presidential elections, see **Electoral College** (table).

Werner Stoy, Camera Hawaii

Hawaii's House of Representatives, in the State Capitol in Honolulu, is the meeting place of the state's representatives.

Early days. The first people to live in what is now Hawaii were the Polynesians. They sailed there in giant canoes from other Pacific islands about 2,000 years ago. Hawaiian legends describe these settlers as dwarfish, playful, and shy. Another Polynesian people moved to the island from Tahiti about A.D. 1200. This group won control over the earlier settlers.

According to one legend, Polynesian settlers named the group of islands *Hawaii* in honor of a chief named *Hawaii-loa.* This chief supposedly led the Polynesians to the islands. But the name *Hawaii* is also a form of *Hawaiki,* the legendary name of the Polynesian homeland to the west.

European exploration. Spanish, Dutch, or Japanese explorers may have stopped at the Hawaiian Islands as early as the 1500's. The rest of the world did not know about the islands until after Captain James Cook of the British navy landed there on Jan. 18, 1778. Cook traded with the Hawaiians, who treated him well. They considered him a great chief with divine powers. Cook named the islands the *Sandwich Islands* in honor of the Earl of Sandwich, first lord of the British admiralty. Cook left after two weeks. He returned in November 1778 and was killed the next year in a quarrel between his men and the Hawaiians. See Cook, James.

Many other traders and explorers sailed to the islands after Cook's landing. They brought livestock, manufactured goods, and plants of other countries.

About 300,000 Hawaiians may have lived on the islands when the first Europeans arrived. The first trading ships known to have stopped at Hawaii arrived in 1786. They were bringing furs from Oregon to China. During the 1800's, many Hawaiians died of diseases brought from other parts of the world.

The kingdom of Hawaii. Local chiefs ruled the islands during the period of Cook's visits. One chief, Kamehameha, gained control of Hawaii Island in a bloody 10-year war that began in 1782. With the aid of firearms obtained from white traders, he captured and united the other main islands in 1795, except for Kauai and Niihau. The local chiefs served as governors of their islands under King Kamehameha I of the Kingdom of Hawaii. In 1810, Kaumualii, ruler of Kauai and Niihau, accepted Kamehameha's rule.

The Great Seafarers, a 1951 oil painting on plywood, by Paul Rockwood (Hawaii Volcanoes National Park)

Polynesians from various Pacific islands were the first people to inhabit the Hawaiian islands. They reached Hawaii in large double canoes some 2,000 years ago. Later, Polynesians arriving from Tahiti gained control of the islands.

Between 1811 and 1830, Hawaii shipped great quantities of sandalwood to China. Money from the sandalwood trade provided a major source of income for Kamehameha I and two later kings. The kings used the money to buy arms, clothing, ships, and other goods.

In 1813, Francisco de Paula Marín, a Spanish settler, wrote of planting pineapples. But commercial development of the pineapple did not begin until the 1880's. The first permanent sugar cane plantation in Hawaii began operating in 1835, at Koloa on Kauai. It was owned by Ladd & Company, an American firm. During the 1800's, hundreds of whaling ships, mostly from the United States, visited Hawaii each year. The sale of fresh water and other supplies to these ships provided the largest income for Hawaiians until the 1860's.

Kamehameha's son, Liholiho, became Kamehameha II after his father died in 1819. As one of his first acts, Kamehameha II abolished the religion of the Hawaiian kingdom. This religion included many orders of priests, the belief in many gods and goddesses, and strict taboos. But the king allowed the practice of personal religious beliefs. In 1820, The American Board of Commissioners for Foreign Missions sent a group of Protestant missionaries and teachers to Hawaii aboard the brig *Thaddeus.* The missionaries converted most of the Hawaiians to Christianity.

The first Roman Catholic missionaries arrived in 1827. But the Hawaiian chiefs considered Protestantism the official religion. The Hawaiians forced the Roman Catholic priests to leave in 1831. They tried to prevent more priests from arriving and imprisoned many Hawaiians who had become Catholics. In July 1839, the French frigate *L'Artémise* blockaded Honolulu. The captain, C. P. T. Laplace, threatened to destroy the town if all the imprisoned Catholics were not freed. He also demanded that religious freedom be granted to Roman Catholics. The Hawaiians gave in to the captain's demands.

Growth of constitutional government. Hawaii adopted its first constitution in 1840. The constitution provided for an executive, a legislature, and a supreme court. The legislature consisted of a council of chiefs and an elected house of representatives. In 1842, the United States recognized the Kingdom of Hawaii as an independent government.

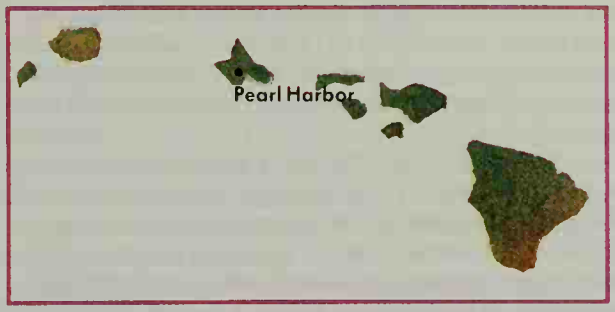
The Hawaiian population declined from about 108,000 in 1836 to about 73,000 in 1853. The decrease was caused by disease and other factors.

Until 1848, the king owned all the islands. He granted or leased various areas to chiefs or people of other countries. A system of private property went into effect in 1848. A law called the *Great Mahele* (division) divided the land among King Kamehameha III and the chiefs. Each of these men gave most of his land to the government. Then the Hawaiian people claimed land or were allowed to buy *homesteads* (small farms). Some Hawaiians sold their land to residents from other countries.

From 1854 to 1872, during the reigns of Kamehameha IV and Kamehameha V, the islands started to become

Historic Hawaii

Captain James Cook, a British naval explorer, reached Hawaii in 1778. His discovery led European traders to the islands.



King Kamehameha I gained control of Hawaii Island after a bloody 10-year war. In 1795 he became the ruler of most of the main islands.

Protestant missionaries from New England converted many native Hawaiians to Christianity in the early 1800's. They founded schools and churches.

Hawaii achieved statehood in 1959, after it had been a territory of the United States for 59 years. Hawaii is the nation's youngest state.

The U.S.S. *Arizona* Memorial honors those who died in the Japanese attack on Pearl Harbor on Dec. 7, 1941. The *Arizona* sank in the attack.

WORLD BOOK illustrations by Kevin Chadwick

Important dates in Hawaii

1778 Captain James Cook of the British navy reached Hawaii.

1795 King Kamehameha I unified Hawaii.

1820 Protestant missionaries from New England arrived to teach islanders Christianity.

1827 Roman Catholic missionaries arrived, but the Hawaiians forced them to leave in 1831.

1835 Ladd & Company started the first permanent sugar plantation in Hawaii on Kauai Island.

1839 The French blockaded Honolulu until the government agreed to give religious freedom to Roman Catholics.

1840 The Kingdom of Hawaii adopted its first Constitution.

c. 1885 The pineapple industry began in Hawaii with the importation of sweet pineapple plants from Jamaica.

1887 King Kalakaua gave the United States exclusive rights to use Pearl Harbor as a naval station.

1893 A revolution led by nine Americans and four Europeans removed Queen Liliuokalani from the throne.

1894 The Republic of Hawaii was established.

1898 The United States annexed Hawaii.

1900 The United States established the Territory of Hawaii.

1903 The legislature first petitioned Congress for statehood.

1927 A. F. Hegenberger and L. J. Maitland made the first airplane flight from the U.S. mainland to Hawaii.

1934 President Franklin D. Roosevelt became the first U.S. President to visit Hawaii.

1941 The Japanese attacked Pearl Harbor on December 7, plunging the United States into World War II.

1950 The territorial legislature approved a state Constitution, which went into effect in 1959—when Hawaii became a state.

1957 The first telephone cable from the U.S. mainland to Hawaii began operation.

1959 Hawaii became the 50th state of the Union.

1960 Hawaiians voted for a President for the first time. Congress established the East-West Center at the University of Hawaii.

1962 The jet-aircraft terminal at Honolulu International Airport was completed.

1965-1969 A new state capitol was built in Honolulu.

1992 Hurricane Iniki caused four deaths and more than $2 billion in damage in Hawaii.

a melting pot of people from various countries. There were not enough Hawaiian workers for the plantations, so owners of the great sugar cane fields brought in laborers from other countries. Many Chinese came to work in Hawaii during the 1850's. Polynesians from the South Pacific first arrived in 1859, and Japanese in 1868. Other immigrants included the Portuguese during the 1870's, and Filipinos, Koreans, and Puerto Ricans in the early 1900's.

King Kalakaua, called the *Merry Monarch,* came to the throne in 1874. During his reign, Hawaiian music, the hula, and many other old Hawaiian customs became popular again. These customs had been prohibited by earlier rulers at the demand of Christian missionaries. The custom of wearing grass skirts began during this period. The first grass skirts were brought then to Hawaii from Samoa.

During Kalakaua's reign, sugar cane planting became a large industry. Planters shipped most of their crop to the United States, especially to San Francisco. The pineapple industry of Hawaii began after a thousand pineapple plants were shipped there from Jamaica about 1885. The plants were imported by Captain John Kidwell, a British *horticulturist* (an expert in growing flowers or fruits). In 1887, Kalakaua gave the United States exclusive rights to use Pearl Harbor as a naval base in exchange for certain trading privileges.

The Republic of Hawaii. King Kalakaua died in 1891, and his sister, Liliuokalani, followed him to the throne. Queen Liliuokalani tried to create a new constitution that would increase her power and change the balance of political power in the kingdom. But in 1893, a revolution by a small force removed her from office. The revolution was led by nine Americans, two Britons, and two Germans. They received the help of American marines and sailors who landed to keep the peace.

The men who led the revolution wanted a more sympathetic government than that of Queen Liliuokalani. They and their followers formed the Republic of Hawaii in 1894. Sanford B. Dole, a judge, became the first and only president of the republic.

The Territory of Hawaii. American business executives controlled the government of the new republic. The sugar cane planters wanted the islands to become a territory of the United States. Then they would receive a special payment when shipping sugar to the mainland. In 1898, the sugar cane planters succeeded in getting the United States to annex Hawaii as a possession in spite of some Hawaiian opposition. On August 12, the formal ceremony of annexation took place. For the next two years, the laws and government of the republic remained in force, except where they differed from the United States Constitution. The islands became a U.S. territory on June 14, 1900, and all Hawaiian citizens became American citizens. President William McKinley appointed Dole the first governor of Hawaii. Hawaii had a population of about 154,000 at this time.

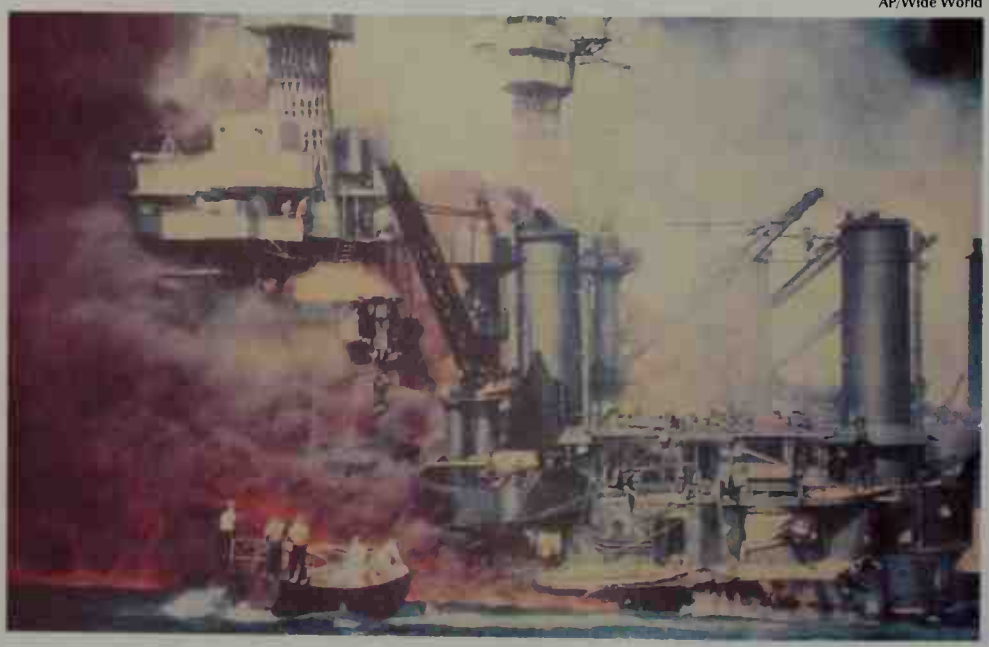
As territorial citizens, the people could not vote in presidential elections. They elected one delegate to Congress. The delegate could introduce bills and debate but could not vote. The voters elected a senate and a house of representatives, but Congress could veto any bill passed by the Hawaiian legislature.

Shortly before World War I (1914-1918), the U.S. Navy started to build a great naval base at Pearl Harbor. The U.S. Army also established camps on Oahu. After the United States entered the war in 1917, two regiments of the Hawaii National Guard were called into federal service. These regiments were not sent overseas, but many Hawaiians fought in Europe as volunteers.

After the war, the statehood movement grew rapidly. The territorial government completed such improvements as draining swampland at Waikiki, now a world-famous beach. In 1927, two U.S. Army lieutenants, A. F. Hegenberger and L. J. Maitland, made the first airplane flight from the U.S. mainland to Hawaii. In 1934, President Franklin D. Roosevelt became the first U.S. President to visit Hawaii.

World War II. On Dec. 7, 1941, planes of the Japanese navy attacked Pearl Harbor and airfields on Oahu. The United States suffered heavy losses in lives, ships, and aircraft. The attack plunged the country into World

AP/Wide World



The attack on Pearl Harbor by Japanese bombers was a key event in U.S. history. Following the Dec. 7, 1941, attack on the U.S. naval base, the United States declared war on Japan and formally entered World War II (1939-1945).

War II. Many damaged or sunken warships were salvaged from Pearl Harbor. The armed forces repaired the damage to the naval base and to the airfields. These bases became the headquarters for the victorious United States campaign against the Japanese. Hawaii was under martial law from 1941 to 1944, though little further fighting took place in the region. See World War II (Japan attacks).

Some Americans feared that people of Japanese ancestry in Hawaii might try to sabotage the war effort. But investigators found no more than one case of disloyalty among islanders of Japanese descent. Many of these islanders fought bravely in Italy and France as members of the famous 100th Infantry Battalion and the 442nd Regimental Combat Team.

The National Memorial Cemetery of the Pacific, in Honolulu, was dedicated in 1949. Thousands of American military personnel killed during World War II and the Korean War (1950-1953) are buried there.

Statehood. In 1919, Jonah Kuhio Kalanianaole, Hawaii's delegate to Congress, introduced the first bill for Hawaiian statehood. Many more statehood bills followed, but most were not even voted on. Several congressional committees wanted the islands to become a state. But many members of Congress feared that the thousands of Asians in Hawaii might not support the United States in a war. The bravery of these Asians in World War II and the Korean War (1950-1953) proved their loyalty.

In 1950, Hawaii adopted a constitution to go into effect when the territory became a state. Finally, in March 1959, Congress approved legislation to admit Hawaii as a state. President Dwight D. Eisenhower signed the bill on March 18. In June, the people of Hawaii voted almost 17 to 1 for statehood. Hawaii became the 50th state on Aug. 21, 1959. In 1960, Hawaiians voted in their first presidential election.

The 1960's. During the 1960's, Hawaii's population increased more than 20 per cent. Hawaii's economy also boomed. The Hawaii Visitors Bureau expanded its campaign on the U.S. mainland to promote tourism. To house the growing number of tourists, hotel construction valued at $80 million was started. A $15 million jet-aircraft terminal at Honolulu was completed in 1962. Jet airliners reduced the flying time between the mainland and Hawaii from nine hours to about five hours. Airfares also were lowered. By the late 1960's, about 1 million tourists were visiting Hawaii every year.

Large companies from the mainland purchased Hawaiian companies in several fields, including banking, insurance, and telephone service. Major Hawaiian corporations expanded their activities into more than 30 countries. Heavy industry also made a start in the state with an oil refinery, a steel mill, and two cement plants.

In 1960, Congress established the Center for Cultural and Technical Interchange Between East and West on the Manoa campus of the University of Hawaii. This institution, known as the East-West Center, provides a place where Americans, Asians, and Pacific Islanders can meet and study together.

Recent developments. Hawaii's economy continues to rely heavily on tourism, with visitors spending about $11 billion annually. During the 1970's, new resort areas were developed on the islands of Hawaii, Kauai, Maui, and Molokai. Increased fuel prices during the 1970's and early 1980's led to higher airfares, which slowed the growth of tourism in the state. But the industry recovered, and today Hawaii has more than 6 million visitors each year. Many tourists come from Japan and other Asian countries.

One of Hawaii's major problems is finding new ways to increase its tourist business while, at the same time, preserving its scenic beauty and recreational attractions. Another problem is the cost of living, which is higher in Hawaii than in most mainland areas. High costs of clothing, food, land, and housing all contribute to this problem.

Manufacturing gained strength in Hawaii during the late 1970's and early 1980's. Food processing, especially sugar refining and pineapple processing, ranks as the state's leading manufacturing activity. Hawaii's *aquaculture* industry gained strength during the late 1970's and early 1980's. Aquaculture is the commercial raising of animals and plants that live in water. The state's aquaculturists raise such animals as fish, oysters, and shrimp.

In order to reduce its dependence on oil, Hawaii is developing alternative sources of energy. These include gasohol (fuel made from gasoline and alcohol), solar energy, geothermal energy, and wind power. Hawaii's goal is to be able to produce all its own energy.

In 1992, Hurricane Iniki struck Hawaii. It caused four deaths and more than $2 billion in property damage. Kauai was hardest hit.

Pauline N. King and Lyndon Wester

Study aids

Related articles in *World Book* include:

Biographies

Cook, James
Damien de Veuster, Joseph
Dole, Sanford Ballard
Fong, Hiram Leong
Kamehameha I
Liliuokalani, Lydia K.

History

Asian Americans (History of Asian immigration)
Cleveland, Grover (Foreign affairs)
Pacific Islands
World War II (Japan attacks)

Military installations

Camp H. M. Smith
Fort Shafter
Hickam Air Force Base
Pearl Harbor

Physical features

Kilauea
Mauna Kea
Mauna Loa
Pacific Ocean
Volcano

Other related articles

Flower (picture: Colorful leis)
Haleakala National Park
Hawaii, University of
Hawaii Volcanoes National Park
Hawaiian honeycreeper
Hilo
Honolulu
Nene
Surfing
United States (picture: Waimea Canyon)

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Questions

What are the eight main islands of Hawaii?
How and when were the islands first united?
Why are airplanes so important in Hawaii?
When did Hawaii become a state?
What is the chief crop of Hawaii?
What are the main features of the Hawaiian language?
What are Hawaii's largest service industries?
Why is Pearl Harbor important in U.S. history?
Who were the first people in Hawaii?
Why is Hawaii called the *Aloha State*?

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Hawaii, University of, is a coeducational, state-supported institution. Its main campus, called the University of Hawaii at Manoa, is in Honolulu. It also operates campuses in Hilo and Pearl City, and seven community colleges. The Manoa campus has colleges of arts and sciences, business administration, continuing education and community service, education, engineering, and tropical agriculture and human resources. It also has schools of architecture; Hawaiian, Asian, and Pacific studies; law; library studies; medicine; nursing; ocean and earth science and technology; public health; social work; and travel industry management; and a graduate division. Courses lead to certificates and to associate, bachelor's, master's, and doctor's degrees. The university was founded in 1907.

Critically reviewed by the University of Hawaii

See also **Hawaii** (picture).

Hawaii Volcanoes National Park is located on the island of Hawaii. The park includes two volcanoes, Mauna Loa and Kilauea. Mauna Loa stands 13,677 feet (4,169 meters) above sea level. It is often called the *Great Builder,* because it pours forth rock to enlarge the mountain. Kilauea's crater looks like a saucer hollowed out in a broad plain. Visitors can view the erupting volcano from the island's shoreline at the base of the mountain. For area, see **National Park System** (table: National parks). The park was established in 1916. In 1961, a section on the island of Maui was designated as Haleakala National Park. See also **Haleakala National Park; Hawaii; Kilauea; Mauna Loa.** Critically reviewed by the National Park Service

Hawaiian goose. See **Nene.**

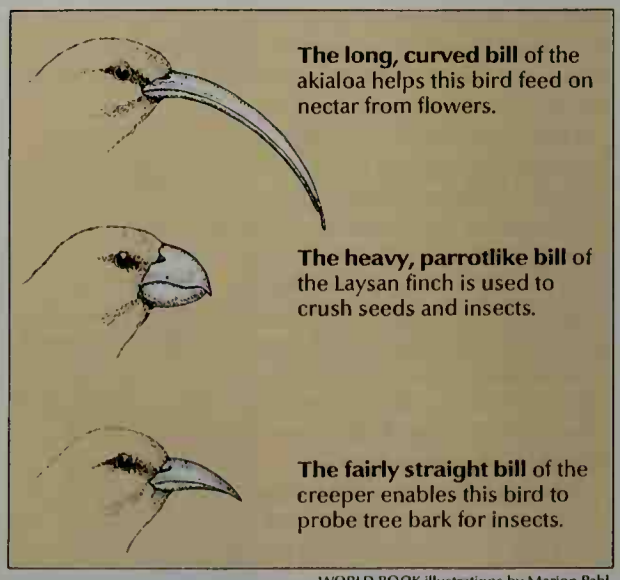
Hawaiian honeycreeper is any member of a family of about 20 species of sparrow-sized birds that live only

The Hawaiian honeycreeper

Hawaiian honeycreepers live only in Hawaii. The apapane, *left,* is one of the most common species. Honeycreepers have three basic kinds of bills, *right,* each suited to a different type of food.

Apapane
Himatione sanguinea
Found in Hawaii
Body length 5 $\frac{1}{4}$ inches (13.3 centimeters)

WORLD BOOK illustration by Harry McNaught



WORLD BOOK illustrations by Marion Pahl

in Hawaii. They get their name from the way honeycreepers *creep* (flutter) about when searching in flowers for insects and nectar.

Originally, there was one species of honeycreeper. The birds wandered to Hawaii or were blown there by a storm. Over time, this species evolved into many species, each with its own feeding habits. Some honeycreepers have a long, curved bill that helps them find food in flowers. Others have a heavy bill for crushing seeds. A third type feeds like a woodpecker, using its strong bill to chisel away tree bark in search of insects.

When Europeans settled in Hawaii in the late 1700's and early 1800's, they brought cats, rats, mosquitoes, and other animals. Some of these animals hunted honeycreepers, and others destroyed much of the forested areas where honeycreepers lived. The mosquitoes carried bird malaria that killed many honeycreepers. About a third of the species of honeycreepers became extinct.

In 1973, two students from the University of Hawaii found a previously unknown species of honeycreeper. This small brown and beige bird was the first bird species discovered in the Hawaiian Islands since 1893.

Scientific classification. Hawaiian honeycreepers make up the subfamily Drepanididae in the finch family, Fringillidae.

James J. Dinsmore

Hawk refers to a type of bird of prey. Hawks belong to a large family of birds that includes ospreys, kites, harriers, Old World vultures, and eagles. Hawks live on every continent except Antarctica.

There are two types of hawks, *accipiters* and *buteos*. Accipiters include such species as the *goshawk* and *Cooper's hawk*. These hawks watch and wait for prey from a perch, such as a tree branch. They have relatively short wings and long tails. Buteos generally have longer wings than accipiters and fan-shaped tails, and they frequently soar in search of prey. They include such species as the *red-tailed hawk* and *Swainson's hawk*.

Hawks hunt a wide variety of animals, including small mammals, reptiles, fish, insects, and other birds. Hawks that prey chiefly on birds have long, thin toes with sharp, curving *talons* (claws). These "bird hawks" include most accipiters. Hawks that eat mammals and reptiles have stouter legs, shorter toes, and thicker talons than do bird hawks. Most buteos belong to this group.

Buteo hawks use their excellent eyesight to spot prey from high up in the air. When a hawk sees its prey, it swoops down and may grasp the animal with its talons. After making a kill, the hawk tears off pieces of the animal with its sharp beak. Some hawks eat bones, feathers, and fur as well as flesh. Because hawks cannot digest everything they eat, they throw up masses of undigested food called *pellets*.

In all species of hawks, the female is larger than the male. Hawks measure from 10 to 27 inches (25 to 69 centimeters) in length and weigh from 3 ounces to 5 pounds (90 grams to 2 kilograms).

Breeding. Some hawks defend a specific area called a *territory*. The territory may be a nesting place, a hunting ground, or a temporary winter home. Both males and females may defend a nesting area. A hawk defends its territory by attacking or threatening intruders. A hawk may threaten intruders by raising the crest of feathers on its head, by calling loudly, or by repeatedly flying back and forth.

Hawks perform courtship displays to attract mates and to warn away other hawks. At times during courtship, a hawk may fly upward steeply and then suddenly dive downward 100 to 1,000 feet (30 to 300 meters). A breeding pair may fly together and may "cartwheel" in the air with their feet joined together. Some hawks keep the same mate for life.

Hawks nest on cliffs, in trees, or on the ground. Some hawks make a nest by simply scraping away a spot on a cliff. Others build elaborate nests of twigs, grasses, and other plant material. Many hawks occupy the abandoned nests of other birds. Many hawks use the same nests for several years. Females lay from one to three eggs each breeding season. Most hawks *incubate* (sit on and warm) their eggs for about 30 to 35 days before they hatch. The female does most of the incubating while the male provides food. This difference in the roles of the sexes may explain why females are larger than males.

At hatching, young hawks are covered by a thin coat of down. This coat is quickly replaced by a thicker down coat. Eventually, both parents hunt prey for the hatchlings. Struggles for food between two or more young often occur. Young hawks grow rapidly and leave the nest in 30 to 60 days.

Migration. Hawks that live in regions with cold winters migrate to warmer areas for the winter. In some species of hawks, birds of all ages migrate. In other species, most of the younger hawks migrate but the adults do not, and some individuals do not migrate every year. Migrating hawks fly during the day and rest at night. Large numbers of hawks of several species may sometimes be seen where migration paths narrow along windy mountain ridges, seacoasts, and lakes. Some species, such as the *broad-winged hawk* and Swainson's hawk, migrate in flocks. Many other species of hawks travel alone. Swainson's hawks have one of the longest migration routes of any hawk. Each year, they fly from Canada and the Northern United States to Argentina.

North American hawks. About 28 species of hawks live in North America. Most of these species are found in the United States and Canada. One of the most common North American hawks is the red-tailed hawk. It inhabits open country and woodlands and may be recognized by its distinctive call, which sounds like "keeeeeer." Swainson's hawk ranges throughout the western part of the United States and western Canada. It has whitish wing linings that contrast with its dark brown flight feathers. The *red-shouldered hawk* has distinctive red to reddish shoulder patches. It lives in the eastern half of the United States and in California. The *rough-legged hawk* breeds in Alaska and northern Canada and winters in most parts of the United States. It has a dark belly that can be seen as the bird hovers in the air in search of prey. The small broad-winged hawk breeds in wooded thickets of the Eastern United States.

Other North American hawks include the goshawk, Cooper's hawk, and the *sharp-shinned hawk*. All three of these hawks prey chiefly on birds. The goshawk lives in Canada, the Western United States, Mexico, and parts of the Eastern United States. Cooper's hawk is found throughout most of the United States. Most sharp-shinned hawks breed in Canada and winter from southern Canada through the United States and Central America.

Red-tailed hawk
Buteo jamaicensis
Found in North and Central America and West Indies
Body length 25 inches (64 centimeters)

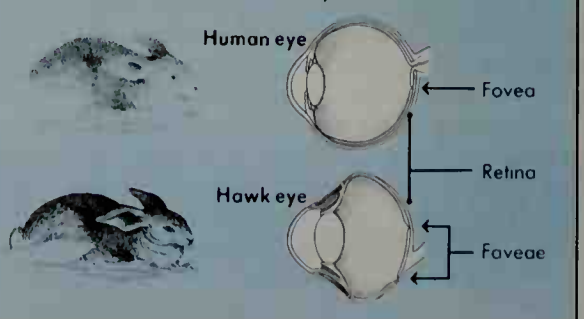
Northern harrier
Circus cyaneus
Found in temperate Northern Hemisphere
Body length 24 inches (61 centimeters)

Goshawk
Accipiter gentilis
Found in temperate Northern Hemisphere
Body length 26 inches (66 centimeters)

WORLD BOOK illustrations by Alben Gilbert

WORLD BOOK diagram by Marion Pahl

A hawk's vision is sharper than a human being's. Its eyes have more light-sensitive cells, and most kinds of hawks have more than one *fovea* (an area of the retina). At a great distance, a person sees a rabbit as a blur, but a hawk sees it clearly.



Scientific classification. Hawks belong to the family Accipitridae. The scientific name for the red-tailed hawk is *Buteo jamaicensis.* Swainson's hawk is *B. swainsoni;* the red-shouldered hawk, *B. lineatus;* the rough-legged hawk, *B. lagopus;* and the broad-winged hawk, *B. platypterus.* Cooper's hawk is *Accipiter cooperii;* the northern goshawk, *A. gentilis;* and the sharp-shinned hawk, *A. striatus.* Thomas G. Balgooyen

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Bird (picture: How birds feed)	Falcon	Kite (bird)
	Falconry	Northern harrier
Buzzard	Harpy eagle	Osprey
Eagle	Harrier (bird)	Vulture

Hawk moth is a member of a worldwide family of large, brightly colored moths that are also called *sphinx moths.* These moths have powerful, streamlined bodies; long, slender front wings; and small hind wings. They fly quickly and skillfully, hovering in front of flowers and sucking nectar, much like hummingbirds. For this reason they are sometimes called *hummingbird moths.* A hawk moth sips nectar through its *proboscis,* a coiled tube extending from the mouth. The proboscis of one species reaches 10 inches (25 centimeters) in length.

The caterpillars often have a sharp horn at the rear end, and are called *hornworms.* When the caterpillars rest, they raise the front part of their body. In profile, they look like the Egyptian sphinx. They spend their pupal stage in the soil, and do not spin cocoons.

Bernd Heinrich

Scientific classification. Hawk moths make up the family Sphingidae.

See also **Death's-head moth; Moth** (pictures).

Hawke, Robert James Lee (1929-), served as prime minister of Australia from 1983 to 1991. He took office after the Labor Party, which he headed, won parliamentary general elections. The Labor Party also won elections held in 1984, 1987, and 1990, and Hawke remained as prime minister. But in 1991—during a recession in Australia—the Labor Party members of Parliament voted to replace Hawke with Paul Keating as head of their party. As a result, Keating also replaced Hawke as prime minister. As prime minister, Hawke worked to create jobs through government spending and to improve relations between business and labor.

Hawke was born on Dec. 9, 1929, in Bordertown, South Australia. He received a law degree from the University of Western Australia and attended Oxford University in England on a Rhodes scholarship. He became a research officer for the Australian Council of Trade Unions in 1958 and was its president from 1970 to 1980. He became well known for settling disputes between labor unions and businesses. He was elected to Australia's House of Representatives in 1980. He became leader of the Australian Labor Party in 1983. J. D. B. Miller

Hawking, Stephen William (1942-), is a British theoretical physicist. He has made what are regarded as the most important discoveries about gravity since German-born physicist Albert Einstein invented general relativity, the modern theory of gravity, in 1915. Hawking's work supports the theory that the universe began in a big bang (see **Cosmology** [Radio waves in space]).

Hawking is probably best known for his theories about *black holes*—invisible bodies in space with such strong gravitational force that not even light can escape them (see **Black hole**). Hawking has used the field of physics called *quantum mechanics* to show that a black hole nevertheless gives off particles and radiation until it eventually explodes and disappears. He continues to work on combining quantum mechanics and gravity in a single theory that would explain the origin and structure of the universe (see **Quantum mechanics**). Hawking's books *A Brief History of Time: From the Big Bang to Black Holes* (1988) and *The Universe in a Nutshell* (2001) became best sellers.

Hawking was born on Jan. 8, 1942, in Oxford, England. In 1966, he received a doctorate from Cambridge University, where he is Lucasian professor of mathematics. Hawking suffers from amyotrophic lateral sclerosis, an incurable disease of the nervous system. He cannot speak or move more than a few hand and face muscles. But using a wheelchair equipped with a computer voice simulator, he still works and travels. Joel R. Primack

Hawkins, Coleman (1904-1969), was the first important improviser on tenor saxophone in jazz. His full rich tone and superb fluency made him one of the most widely imitated instrumentalists of the 1930's and 1940's.

Hawkins was born on Nov. 21, 1904, in St. Joseph, Missouri. While a teen-ager, he went to New York City with a jazz group that accompanied blues singer Mamie Smith. From 1923 to 1934, while playing in Fletcher Henderson's orchestra, he gained an international reputation. He was extremely popular in other countries and he moved to Europe in 1934, returning to the United States in 1939. He recorded an improvised solo based on the song "Body and Soul" in 1939. It became a best seller and his most memorable performance. After 1940, Hawkins led small groups and toured with the "Jazz at the Philharmonic" concert series. Frank Tirro

Hawkins, Sir John (1532-1595), also spelled *Hawkyns,* was an English sea captain during the reign of Queen Elizabeth I. He was a fearless adventurer but also the first English slave trader. In 1568, the Spaniards attacked his fleet in a Mexican harbor. He survived, but the incident added to growing hostility between England and Spain. In 1585, England helped rebels in Holland fight against Spanish rule there, thus provoking war between England and Spain. In 1588, Hawkins helped command the ships that successfully defended England against the Spanish fleet called the Armada. He was knighted in the battle. Hawkins was born in Plymouth, England.

Richard L. Greaves

See also **Drake, Sir Francis.**

Hawks, Howard (1896-1977), was an American motion-picture director known for his action films. Hawks also helped create a fast-paced style of comedy called *screwball comedy,* which ridiculed the eccentric or silly behavior of wealthy characters.

Two of Hawks's finest films deal with World War I (1914-1918). One of them, *The Dawn Patrol* (1930), describes the adventures of fighter pilots in the war. The other, *Sergeant York* (1941), tells the true story of the American soldier Alvin C. York, who became one of the war's most famous heroes. Hawks directed several Westerns, including *Red River* (1948) and *Rio Bravo* (1959). His violent melodrama *Scarface* (1932) became one of Hollywood's most famous gangster movies. His film *The Big Sleep* (1946) ranks among the best private detective movies ever made. Hawks's most successful comedies were *Twentieth Century* (1934), *Bringing Up Baby* (1938), and *His Girl Friday* (1940).

Hawks was born in Goshen, Ind. He entered the film industry in 1918 as a writer and editor. After making a number of short films, he directed his first feature film, *The Road to Glory* (1926). Hawks directed about 40 films.

John F. Mariani

Hawthorn, also called *thorn apple,* is the name of more than 600 species of thorny shrubs or small trees that bear fragrant flowers. Hawthorns are native to North America, Europe, and northern Africa. Their blossoms are white or, rarely, pink or red. The *English hawthorn* is noted for its beauty in May, when it blooms. The English countryside then becomes white with hawthorn blossoms.

Hawthorns are *deciduous*—that is, they lose their leaves each autumn. The leaves change to scarlet, bronze-red, or yellow before they are shed. The fruit, called a *haw,* is fleshy with a paperlike core. It is red to red-orange and looks like a small apple. For this reason, the hawthorn is sometimes called *red haw* or *scarlet haw.* The fruit ripens from September to October.

© A-Z Collection from Photo Researchers

A hawthorn produces fragrant flowers. In autumn, its leaves change to scarlet, bronze-red, or yellow. The *English hawthorn, above,* blooms in May.

The *downy hawthorn* is a type of hawthorn found in the United States. This small tree has crooked, spreading branches and white blossoms. The orange-scarlet haws ripen late in the summer but fall soon after they mature. Another American hawthorn, the *cockspur,* sometimes grows 25 feet (8 meters) tall. Its red fruit remains on the tree from fall through winter.

Scientific classification. Hawthorns belong to the rose family, Rosaceae. The English hawthorn is *Crataegus laevigata.* The downy hawthorn is *C. mollis,* and the cockspur is *C. crus-galli.*

Fred T. Davies, Jr.

See also Missouri (picture: The state flower); **Tree** (Familiar broadleaf and needleleaf trees (picture)).

Hawthorne, Nathaniel (1804-1864), ranks among America's major authors. Between about 1825 and 1850, he developed his talent by writing short fiction and the novel *Fanshawe* (1828). Then he gained international fame for his novel *The Scarlet Letter,* a masterpiece of American literature.

Hawthorne's works probe into human nature, especially its darker side. He set many stories against the somber background of Puritan New England, the world of his ancestors. Unlike most fiction writers of his time, he was not primarily interested in stirring the reader by sensational or sentimental effects. Hawthorne called his writing *romance,* which he defined as a method of showing "the depths of our common nature." To Hawthorne, romance meant confronting reality, rather than evading it. Hawthorne often dealt with the themes of morality, sin, and redemption. Among his early influences were the parables and allegories of John Bunyan and Edmund Spenser.

Nathaniel Hawthorne by Charles Osgood. Essex Institute, Salem, Mass.

Nathaniel Hawthorne

Life. Nathaniel Hathorne was born in Salem, Mass. He added the *w* to his name when he began publishing. Hawthorne graduated from Bowdoin College in 1825. While attending Bowdoin, he became a friend of future U.S. President Franklin Pierce. After college, he settled in Salem and continued writing. Hawthorne worked in the Boston Custom House in 1839 and 1840 and was a member of the idealistic Brook Farm community near Boston briefly in 1841 (see **Brook Farm**).

Hawthorne married Sophia Peabody in 1842. They moved to the now-famous *Old Manse* in Concord, Mass., where he continued writing. See **Concord.**

Hawthorne was surveyor of customs in the port of Salem from 1846 to 1849. In 1853, President Pierce appointed Hawthorne to a four-year term as United States consul in Liverpool, England. After 1857, Hawthorne lived in Italy and again in England before returning to Concord in 1860. He died on May 18 or 19, 1864, while visiting New Hampshire with Pierce.

His stories and sketches. Between 1825 and 1850, Hawthorne wrote more than 100 tales and sketches for periodicals. Most of these works were collected in *Twice-Told Tales* (1837, 1842, 1851), *Mosses from an Old Manse* (1846), and *The Snow Image and Other Twice-Told Tales* (1851).

The stories and sketches reveal themes central to Hawthorne's imagination. He was haunted by the Puritan society of Massachusetts during the 1600's. To him, the society was represented by his stern forefathers, especially John Hathorne, who was a judge during the Salem witchcraft trials. Hawthorne painted a grim picture of the Puritan past in "Young Goodman Brown," "The Maypole of Merrymount," and other short stories. He was one of the first writers in the United States to re-create the past of his native region. Hawthorne showed the effects of secret guilt in "The Minister's Black Veil" and other stories. In "Wakefield," he described the effects of voluntary isolation from society.

In "The Birthmark," "Ethan Brand," and "Rappaccini's Daughter," three of Hawthorne's finest stories, the central characters suffer from intellectual pride. Hawthorne called such pride "the Unpardonable Sin," describing it as the "sin of an intellect that triumphed over the sense of brotherhood with man and reverence with God." Other stories, such as "The Artist of the Beautiful," show Hawthorne's concern for the artist's role in society. In "My Kinsman, Major Molineux," Hawthorne treated the conflict between youth and established authority.

Hawthorne's sketches deal chiefly with New England scenes of his time. They range in tone from the light whimsy of "A Rill from the Town Pump" to the satire of "The Celestial Railroad" and the dark fantasy of "The Haunted Mind." Hawthorne also wrote two popular children's books, *A Wonder Book for Boys and Girls* (1852) and *Tanglewood Tales* (1853).

His novels. *The Scarlet Letter* (1850) is introduced by "The Custom House," an essay in which Hawthorne sketched the novel's background and his experiences as a customs official while writing the book.

The novel itself is controlled by a single idea—the suffering that results from sin. Hawthorne believed that sin—adultery in *The Scarlet Letter*—results in the isolation of the sinners. Isolation leads to suffering, and suffering leads to further sinning and further suffering. The spiral continues until the sinners either destroy themselves or seek forgiveness and rejoin the community.

The Scarlet Letter is set in Puritan Boston. The plot is formed by the interactions of the adulteress Hester Prynne, the adulterer Arthur Dimmesdale, and Hester's husband, Roger Chillingworth. Hester symbolizes the force of love. Dimmesdale, a minister, represents the spirit, and Chillingworth symbolizes the mind.

Hawthorne shaped his tale in four parts, each dominated by a single force. The force in the first section (Chapters 1-8) is the Puritan community; in the second (Chapters 9-12) it is Chillingworth; in the third (Chapters 13-20) it is Hester; and in the closing part, Dimmesdale. Each section centers on one great dramatic scene in a symbolic setting. The symbolic setting in the first, second, and fourth sections is the scaffold in the Boston marketplace, on which sinners were exhibited and shamed. The forest with its darkness is the symbol in the third section. Hawthorne expanded and intensified the meaning of the action by pictures of light and dark colors he created verbally and by his quiet, ironic tone.

The House of the Seven Gables (1851) tells the story of a curse placed on the House of Pyncheon by Matthew Maule, a victim of the Salem witchcraft trials. Hawthorne traces the curse's effect on the Pyncheon descendants and describes their final reconciliation to their past.

The Blithedale Romance (1852), a tragic love story, is Hawthorne's closest approach to a novel of observed life. Hawthorne drew his characters in part from the men and women he had known in the Brook Farm community.

The Marble Faun (1860) is a psychological study of two young American artists in Italy and their relationship with a mysterious woman painter and a young nobleman. John Clendenning

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© David R. Frazier

Hay is harvested with a baler. The baler shown here presses the cut hay into rectangular bales and then ties them with twine.

Hay consists of the dried stems and leaves of plants, and serves as feed for cattle, horses, and other animals. Hay is most often made from a *legume,* such as alfalfa or clover, or from a forage grass, such as orchard-grass, smooth brome, or timothy. Hay commonly consists of a mixture of legumes and grasses. In some areas, farmers make hay from wild prairie grasses.

Farmers have traditionally cut hay with a sickle mower and left it on the ground to dry. A machine called a *conditioner* crushed the hay, which reduced the drying time. Farmers then raked the hay into long rows called *windrows* and allowed it to dry further. Today, many farmers use a machine called a *swather* that cuts, conditions, and windrows hay in one operation.

Farmers take great care to dry hay properly before storing it. Hay that contains too much moisture will spoil. In addition, as the damp hay spoils, enough heat may be created to start a fire. A mechanical dryer can speed the drying process and prevent the hay from getting wet when it rains. However, mechanical drying is costly, and so it is rarely used.

After the hay has been cut and dried, farmers use special machines to prepare it for storage. Some farmers use baling machines that gather the hay into rectangular bales weighing from 50 to 150 pounds (23 to 68 kilograms). The balers then tie the bales with wire or twine. The farmer stacks the bales onto a wagon by hand or by means of automated equipment. The wagon transports the bales to barns or outdoor storage areas.

Other farmers store hay in large round or rectangular bales that weigh from 1,000 to 2,000 pounds (455 to 910 kilograms). These bales are tied with heavy plastic twine and moved with equipment mounted on a tractor. To keep rectangular bales dry, farmers may cover them with loose hay, plastic, or canvas. Round bales can be stored uncovered because they shed water better.

Machines called *haystackers* compress hay into large loaves that weigh from 2,000 to 16,000 pounds (910 to 7,300 kilograms). Other machines then unload the loaves in the storage area.

Sometimes, farmers choose to chop the hay before storing it. In this case, a *forage harvester* cuts the hay into short pieces and blows it onto a wagon or truck. Farmers can store chopped hay in barns or process it into small wafers or cubes. Kay H. Asay

See also Alfalfa; Horse (Food); Rake.

Hay, John Milton (1838-1905), was an American diplomat and statesman. He is best remembered for his Open-Door Policy in China.

In 1899, powerful European nations and Japan were

trying to extend their influence over the weak Chinese Empire. Hay was United States secretary of state at that time, and he feared that the division of China would hurt American trade. He asked the United Kingdom, Russia, Germany, France, Italy, and Japan to respect the rights of all nations to trade in China on an equal basis. This he called the *Open-Door Policy* (see **Open-Door Policy**). The next year, the Boxer Rebellion broke out in China against Western and Japanese influence there (see **Boxer Rebellion**). Because of European reaction to the rebellion, Hay went beyond the Open Door to ask the other countries to keep China undivided and independent. The nations did not give the strict promises Hay wanted, but American policy did help prevent the breakup of China.

Hay was born in Salem, Indiana. He graduated from Brown University and began practicing law in Springfield, Illinois, in 1861. When Abraham Lincoln became president in 1861, he made Hay his assistant private secretary. After Lincoln's death in 1865, Hay served as a U.S. diplomat in Paris, Vienna, and Madrid.

In 1870, Hay became an editorial writer on the *New York Tribune*. For several years, he spent most of his time writing. In 1897, Hay was appointed U.S. ambassador to the United Kingdom. From 1898 until his death, he served as secretary of state under Presidents William McKinley and Theodore Roosevelt.

Hay based his foreign policy on close cooperation between the United States and the United Kingdom. He worked with the British in his policy toward China, in settling a dispute over the boundary between Alaska and Canada, and in preparing the way for the Panama Canal (see **Hay-Pauncefote Treaty**). Hay and American writer John G. Nicolay coauthored the 10-volume *Abraham Lincoln: A History* (1886-1890). Hay also wrote poems, fiction, and essays. Robert W. Cherny

Hay fever is an allergy that occurs most frequently during the spring, summer, and fall. Grasses, trees, and weeds produce pollen during those seasons, and hay fever sufferers are allergic to pollen. Like most allergies, hay fever runs in families. A person can develop the allergy at any age. The medical name for hay fever is *pollinosis*. See **Allergy**.

Symptoms of hay fever include runny, red, and itching eyes and a runny, stopped-up nose. The nose may also itch and swell. Hay fever victims have repeated periods of sneezing and may temporarily lose their sense of smell. A victim's ears may be stopped up as well.

About a third of those who suffer from hay fever develop seasonal asthma. Hay fever also may result in *sinusitis*, a sinus infection. In addition, it may cause the development of infection or of growths called *polyps* in the mucous membrane. See **Asthma**; **Sinus**.

Causes and prevention. The most common cause of hay fever in the United States is the pollen of the ragweed plant. In most areas, ragweed produces pollen in the late summer or fall. See **Ragweed**.

The pollen of other plants also causes hay fever. For example, Russian thistle is a major cause of hay fever in New Mexico and Utah. Airborne fungi and molds can also cause the allergy in some people or even increase the seriousness of its symptoms.

Hay fever can be prevented or made less severe by avoiding the offending pollens. Some communities have tried to eliminate ragweed. But wind carries pollen considerable distances, and elimination programs have not generally been successful.

Many newspapers and radio and television stations in the United States announce the daily local *pollen index* during the summer months. This figure is based on the number of ragweed pollen grains in 1 cubic yard (0.8 cubic meter) of air. The Midwestern States have the greatest concentration of pollen in the country. Areas with little ragweed pollen include the Pacific Coast and the southern tip of Florida.

Treatment. Hay fever has the same symptoms as a year-round condition called *perennial allergic rhinitis*. A physician performs tests to identify the causes of a patient's allergy. If the person has hay fever, the doctor performs tests to discover which pollen, fungus, or mold caused it. Most people with allergic rhinitis are sensitive to any kind of dust—especially house dust—and to some foods and even to animal dandruff.

Most doctors prescribe drugs called *antihistamines*, which provide quick relief for some sufferers. These drugs should be taken only under a doctor's supervision because they cause dangerous side effects in some people. Other types of drugs lessen the swelling of the membranes lining the nose and relieve runny nose.

If a patient is extremely sensitive to pollen, the doctor may prescribe *hyposensitization*. This treatment involves injecting pollen extract into the patient's body at regular intervals, slowly increasing the strength of the concentration of the extract. The injections cause the body to form antibodies to help fight the allergic reaction. In most cases, this therapy helps provide relief from hay fever symptoms. Joan S. Gallagher

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Hay-Pauncefote Treaty, *HAY PAWNS fut,* enabled the United States to build the Panama Canal. It was signed by the United States and the United Kingdom in 1901. The treaty gave the United States the sole right to build or supervise the construction of a canal across the Central American isthmus, as well as the right to manage it. All nations were to pay fair and equal traffic charges and enjoy equal rights during peacetime. In wartime, the United States could close the canal to any nation. The United Kingdom admitted that the United States also had the right to fortify and defend the canal. The treaty was named for its negotiators—U.S. Secretary of State John Milton Hay and British ambassador to the United States Sir Julian Pauncefote.

Steve C. Ropp

See also **Panama Canal**; **Clayton-Bulwer Treaty**.

Hayakawa, *HAH yah KAH wah,* **S. I.** (1906-1992), an American educator, became an internationally known expert on *semantics* (the study of the meaning of words). His many writings include the books *Language and Action* (1941)—later retitled *Language in Thought and Action*—and *Symbol, Status, and Personality* (1963). Hayakawa became acting president of San Francisco State College (now San Francisco State University) in 1968 and served as its president from 1969 to 1973. In

1968, he gained national fame for his firm stand against student strikers who tried to close the college. Hayakawa, a Republican, represented California as a United States senator from 1977 to 1983.

Samuel Ichiye Hayakawa was born in Vancouver, Canada, to Japanese immigrants. He graduated from the University of Manitoba and earned graduate degrees at McGill University and the University of Wisconsin. In 1954, he became a U.S. citizen. He joined the faculty of San Francisco State College in 1955. Gerald L. Gutek

Hayden, Carl Trumbull (1877-1972), an Arizona Democrat, served in the United States Congress from 1912 until 1969—longer than any other person. He served in the House of Representatives from 1912, when his state was admitted to the Union, until 1927, when he entered the U.S. Senate. Hayden became chairman of the Senate Committee on Appropriations in 1955. He served as president *pro tempore* of the Senate from 1957 to 1969, when he retired. Hayden advocated legislation to advance forest preservation, federal highway construction, and irrigation of dry regions. Hayden was born in Hayden's Ferry (now Tempe), Arizona. He attended Stanford University. Paul Hubbard

Hayden, *HAYD uhn,* **Melissa** (1923-), is a Canadian-born ballerina. She gained international fame as a principal dancer with the New York City Ballet under its artistic director, George Balanchine. He created several ballets for Hayden, including *Agon* (1957) and *A Midsummer Night's Dream* (1962).

Hayden was born in Toronto. Her real name was Mildred Herman. Hayden danced with the New York City Ballet from 1950 until she retired in 1973. She also performed with the Ballet Theatre (now the American Ballet Theatre) from 1945 to 1947 and in 1953 and 1954. After her retirement, she became a ballet teacher, director, and coach. She has written two books: *Melissa Hayden, Off Stage and On* (1963) and *Dancer to Dancer: Advice for Today's Dancer* (1981). Katy Matheson

Haydn, *HYD uhn,* **Joseph** (1732-1809), was an Austrian composer. He ranks among the most important composers to lead the development of instrumental and vocal music during the middle and late 1700's. Many of his compositions helped set standards for musical style and taste in the late 1700's.

Haydn wrote over 80 string quartets and established many of the basic characteristics of that form. He also wrote many other chamber works, mainly trios. His symphonies are numbered through 104, but he probably wrote about 108. His later symphonies are among the most complex and mature works of his day. Haydn gave many of them titles associated with an aspect of the symphony. For example, Symphony No. 94 is called the *Surprise* because it includes an unexpected loud chord shortly after the soft beginning of the second movement. Among Haydn's other instrumental works are overtures, concertos, incidental music for theater works, sonatas, and pieces for harpsichord or piano.

Haydn wrote a number of cantatas and oratorios, the most significant being his oratorio *The Creation* (1798). He also composed masses for chorus, soloists, and small orchestra. Haydn wrote several operas, but they are seldom performed today.

Franz Joseph Haydn was born in Rohrau, near Vienna. At the age of 8, he was admitted to the choir of St. Stephen's Cathedral as a soprano. After his voice changed, he continued to live in Vienna while working as a teacher and free-lance musician. He also studied music, notably with the Italian composer Nicola Porpora.

In 1761, Haydn began his employment with the Esterházy family, who were wealthy Hungarian nobility. For about 30 years, he was responsible for composing and performing most of the music at the Esterházy court. In that position, Haydn wrote many chamber works, keyboard pieces, and symphonies, and almost all his operas. In 1781, Haydn met the young Wolfgang Amadeus Mozart, and the two seem to have become close friends who admired each other's compositions.

After Prince Nikolaus Esterházy died in 1790, Haydn made Vienna his permanent home. In 1791, he visited England at the invitation of the music promoter Johann Peter Salomon to present a number of concerts. While returning to Vienna, Haydn stopped in Bonn, Germany, where he met the young Ludwig van Beethoven and agreed to accept him as a pupil. In 1794, Haydn returned to London to present more concerts. During his London visits, he wrote 12 symphonies (numbers 93 to 104), known as his *London symphonies.* Daniel T. Politoske

See also **Classical music** (The Classical period).

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Hayes, Helen (1900-1993), was an American actress. Many critics consider the role of Queen Victoria in the play *Victoria Regina* (1935) her greatest success. Hayes won the 1931-1932 Academy Award as best actress for her performance in *The Sin of Madelon Claudet,* which was her first film. She received the 1970 Academy Award as best supporting actress for her performance in *Airport.*

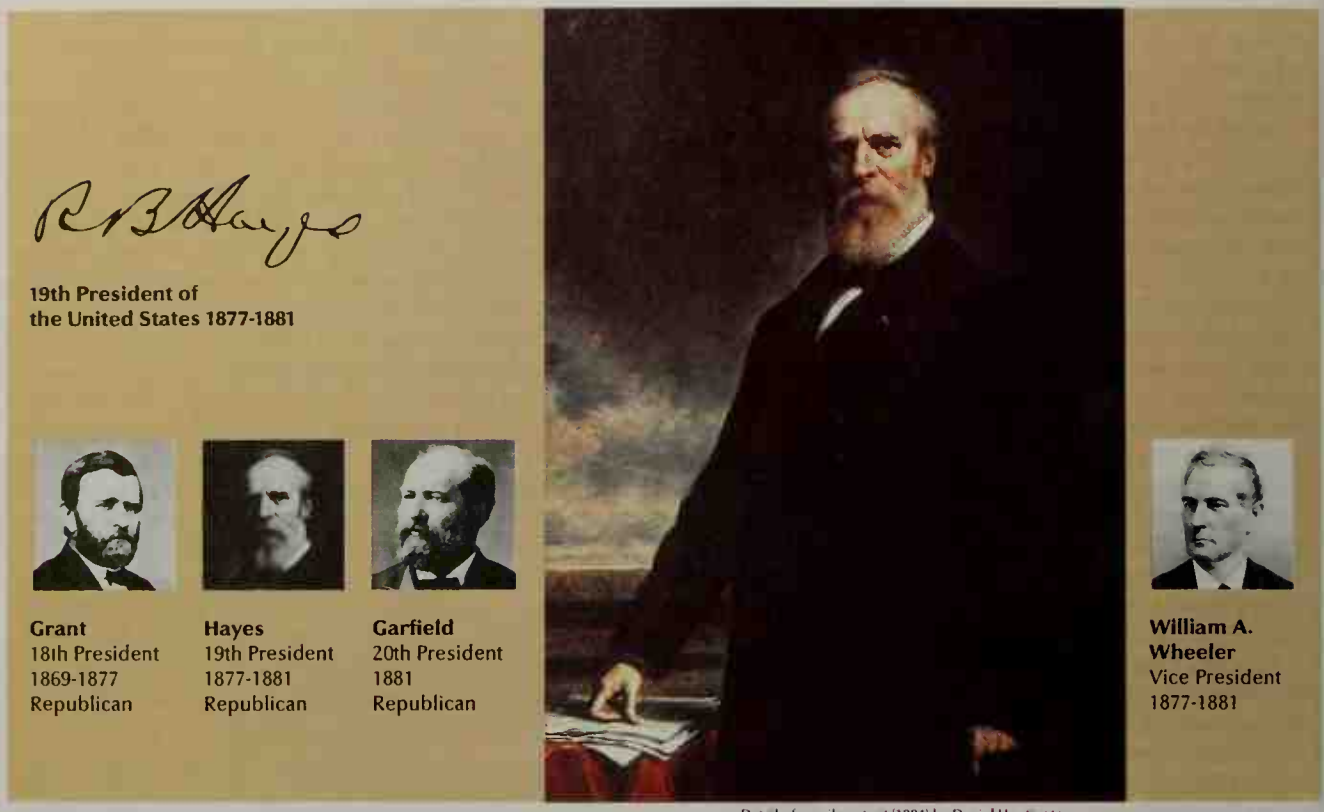
Friedman-Abeles

Helen Hayes

Hayes made her stage debut in 1905. Her performance in J. M. Barrie's play *Dear Brutus* in 1918 made her a star. She retired from the stage in 1971, although she continued to act occasionally in movies and on television.

Helen Hayes Brown was born in Washington, D.C. In 1928, she married playwright Charles MacArthur. Hayes wrote about her life in *On Reflection* (1968) and *My Life in Three Acts* (1990). Don B. Wilmeth

Hayes, Roland (1887-1977), was a famous black American lyric tenor. His song recitals gained him an international reputation. However, racial barriers excluded him from the opera career for which he would have been well suited. Hayes was born in Curryville, Georgia, and attended Fisk University. He gave his first concert in 1916 and later appeared with leading orchestras in Europe and America. Hayes won the 1924 Spingarn Medal (see **Spingarn Medal**). Martin Bernheimer



Detail of an oil portrait (1884) by Daniel Huntington; © White House Historical Association (photography by the National Geographic Society)

Hayes, Rutherford Birchard (1822-1893), was elected President by a margin of only one electoral vote. His victory over Samuel J. Tilden in 1876 climaxed the most disputed presidential election in United States history. Congress had to create a special Electoral Commission to decide the winner.

Hayes was a studious, good-natured man who enjoyed books more than politics. Ohio Republicans nominated him for Congress while he was fighting in the Civil War. Hayes refused to campaign. He declared that any officer who "would abandon his post to electioneer for a seat in Congress, ought to be scalped." Hayes won the election. He later served three terms as governor of Ohio.

When Hayes became President, the nation was suffering from a business depression and the political scandals of the previous Administration of Ulysses S. Grant. The unsolved problem of Reconstruction in the South still divided the American people, even though the Civil War had ended 12 years before. Hayes was not popular at first. Democrats charged he had "stolen" the election. His fellow Republicans were bitter because he refused to give special favors to party politicians.

However, by the time Hayes left office, most Americans respected him for his sincerity and honesty. He had promised to end Reconstruction, and he did. Within two months after he took office, the last federal troops marched from the South. Hayes also put the government on the path toward civil service reform. Throughout his career, Hayes tried to live by his motto: "He serves his party best who serves his country best."

During Hayes's Administration, the United States continued its remarkable growth. The nation became more industrialized than ever before, and labor unions gained thousands of new members. The population of New York City soared above a million. Civil War General Lew Wallace won nationwide fame for his novel *Ben-Hur*. And Thomas A. Edison visited the White House to demonstrate his favorite invention, the phonograph.

Early life

Rutherford Birchard Hayes was born on Oct. 4, 1822, in Delaware, Ohio. He was the fifth child of Rutherford Hayes, Jr., and Sophia Birchard Hayes. The family had migrated to Ohio from Dummerston, Vt., in 1817. Hayes had two brothers and two sisters, but only he and his sister Fanny grew to adulthood. Hayes's father, a successful store owner, died two months before Rutherford, or "Rud," was born. A bachelor uncle, Sardis Birchard, became the children's guardian.

Education. Hayes was a champion speller in elementary school. He later boasted that "not one in a thousand could spell me down!" Hayes prepared for college at private schools in Norwalk, Ohio; and Middletown, Conn. In 1838, he entered Kenyon College in Gambier, Ohio. He graduated in 1842 at the head of his class. Hayes entered Harvard Law School the next year. He graduated and was admitted to the bar in 1845.

Lawyer. Hayes began practicing law in Lower Sandusky (later Fremont), Ohio, where his uncle lived. In 1850, he opened a law office in Cincinnati. At first, Hayes had so few clients and was so poor that he slept in his office to save money. He enjoyed studying literature, and joined the recently formed Literary Club of Cincinnati.

Hayes's law practice gradually increased. In 1852, he won statewide attention as a criminal lawyer in two widely publicized murder trials. His brilliant defense ar-

Railroad workers rioted during a nationwide strike in 1877. Hayes called out federal troops to restore order.

The electric light was invented by Thomas Edison in 1879. In 1877, Edison had invented a phonograph.

The U.S. flag gained a 38th star in 1877, marking Colorado's entry into the Union in 1876 as the 38th state.

The world of President Hayes

Reconstruction ended in 1877, when the last federal occupation troops were withdrawn from the South.
Flag Day was first officially celebrated on June 14, 1877.
The first black cadet to graduate from the United States Military Academy at West Point was H. O. Flipper, in 1877.
Henry M. Stanley, a Welsh explorer, reached the mouth of the Congo River in 1877, after a nearly three-year journey across Africa. He became the first white person to trace the river from Central Africa to its mouth on the Atlantic coast.
Famous books published during Hayes's presidency included *Black Beauty* (1877), a novel by Anna Sewell protesting cruel treatment of horses; *Ben-Hur: A Tale of the Christ* (1880), a novel by Lew Wallace; and *Uncle Remus: His Songs and His Sayings* (1880), a collection of Southern black folk tales by Joel Chandler Harris.
The Russo-Turkish War of 1877-1878 gave Russia control of important areas in the Caucasus region, near the Black Sea.
The first commercial telephone exchange opened in New Haven, Conn., in 1878. It had 21 subscribers.
The woman suffrage amendment was proposed in the United States Congress for the first time in 1878.
The first journalism course was given at the University of Missouri in 1879.
The first woman lawyer to practice before the Supreme Court of the United States was Belva Ann Lockwood, in 1879.
Wilhelm Wundt, a German philosopher, established one of the first laboratories of experimental psychology in 1879.

The Rutherford B. Hayes Presidential Center; Consolidated Edison Company of New York, Inc.

guments saved his clients from receiving the death penalty. In 1858, the Cincinnati City Council elected Hayes to fill a vacancy as city solicitor. He held this influential political and legal post until shortly before the Civil War began three years later.

Hayes's family. On Dec. 30, 1852, Hayes married Lucy Ware Webb (Aug. 28, 1831-June 25, 1889). They had eight children, but three died in infancy.

Lucy Hayes was the daughter of a Chillicothe, Ohio, physician. She had graduated in 1850 from the Wesleyan Female College in Cincinnati, and was the first President's wife to have a college degree. Her intelligence and social grace helped Hayes throughout his career. Mrs. Hayes championed many of the leading moral causes of the day. She became active in supporting the abolition of slavery, prohibition of alcohol, and aid to the poor.

Soldier. When the Civil War began in 1861, the Literary Club of Cincinnati formed a military drilling company, and elected Hayes captain. He was later appointed a major of a regiment of Ohio Volunteers. Hayes distinguished himself in several battles, and earned rapid promotion during his four years in the Army. He was wounded four times and had four horses shot from under him. On June 8, 1865, two months after the war ended, Hayes resigned from the Army with the rank of brevet major general.

Important dates in Hayes's life

1822	(Oct. 4) Born in Delaware, Ohio.
1852	(Dec. 30) Married Lucy Ware Webb.
1864	Elected to the U.S. House of Representatives.
1867	Elected governor of Ohio.
1876	Elected President of the United States.
1893	(Jan. 17) Died in Fremont, Ohio.

Political career

Congressman. Hayes was nominated for the U.S. House of Representatives in 1864. He received the news while fighting in the Shenandoah Valley under General Philip H. Sheridan. He refused to campaign for the office because the outcome of the war was still in doubt. Hayes won the election, but did not take his seat in Congress until December 1865. He won reelection in 1866,

Brown Bros.

Hayes's birthplace, a brick house in Delaware, Ohio, *above,* was later used as a store. The building was torn down in 1928, and a bronze tablet now marks the site.

Detail of an oil portrait (1881) by Daniel Huntington; © White House Historical Association (photography by the National Geographic Society)

Lucy Webb Hayes was the first President's wife to have a college degree. She often was called "Lemonade Lucy" because she refused to serve alcoholic beverages at the White House.

but resigned in July 1867, a month after he was nominated for governor of Ohio.

While in Congress, Hayes did outstanding work as chairman of the Joint Committee on the Library of Congress. Under his leadership, Congress transferred the scientific library of the Smithsonian Institution to the Library of Congress.

Governor. In 1867, Hayes won election to the first of three terms as governor of Ohio. His election was a personal triumph because he campaigned in favor of an unpopular black suffrage amendment to the state constitution. Hayes planned to retire from politics at the end of his second term in 1872. But Republican leaders persuaded him to run for Congress. He was defeated, and spent the next three years at his home near Fremont, Ohio, where he lived quietly and dealt in real estate. In 1875, he won a third term as governor.

Hayes gained nationwide attention as a courageous administrator. He worked hard for economy in government and for a strong civil service program based on merit rather than political influence. He also helped establish the college that became Ohio State University.

Campaign of 1876. As President Grant's second term drew to a close, the corruption-torn Republican Party split into two main factions. The *Stalwarts,* who were led by Senator Roscoe Conkling of New York, favored a third term for Grant. The *Half-Breeds,* who were led by Representative James G. Blaine of Maine, opposed the Stalwarts. Grant refused to run for a third term, but neither the Stalwarts nor the Half-Breeds had enough votes to nominate a presidential candidate. Many of the party leaders supported Hayes as a compromise candidate. At the Republican National Convention in June 1876, Hayes won the presidential nomination on the seventh ballot. The delegates nominated Representative William A. Wheeler of New York for Vice President.

Samuel J. Tilden, who had gained fame as a reform governor of New York, was Hayes's Democratic opponent. The Democrats chose Governor Thomas A. Hendricks of Indiana for Vice President. The new Greenback Party nominated Peter Cooper for President (see **Greenback Party**).

The Republicans seemed to have little chance for victory. The Democrats had increased their voting strength since 1874, when they gained control of the U.S. House of Representatives. As election day approached, however, President Grant sent federal troops to South Carolina and Louisiana to protect the rights of black voters, and gain support for the Republicans. Tilden received 4,288,546 popular votes to 4,034,311 for Hayes.

The election dispute. Four states—Louisiana, South Carolina, Florida, and Oregon—submitted two sets of electoral returns, one by the Democrats and one by the Republicans. As a result, both parties claimed victory. On December 6, the Electoral College met and voted. Hayes received 165 unquestioned votes. Tilden got 184 votes, one short of a majority. Twenty electoral votes, from the four states that submitted conflicting returns, were disputed. In January 1877, Congress appointed a 15-member Electoral Commission to settle the matter (see **Electoral Commission**). Its decisions were to be final, unless both houses of Congress voted otherwise. During the debate in Congress, members of both parties threatened to seize the government by force.

As Inauguration Day approached, leaders of both parties feared that the country might be left without a President. In a private meeting, Southern Democrats in Congress agreed not to oppose the decision of the Electoral Commission. This agreement gave Hayes the presidency because the Commission had a Republican majority. In exchange, the Republicans promised to end Reconstruction and withdraw federal troops from the South (see **Reconstruction**). Southerners thus regained complete political control over their state and local governments for the first time since the Civil War. On March 2, 1877, just 56 hours before Inauguration Day, Hayes was formally announced as the winner.

Hayes's Administration (1877-1881)

The end of Reconstruction. One of Hayes's first acts as President was to withdraw federal occupation forces from the South, as promised. On April 10, 1877, the soldiers left South Carolina, and on April 24, the last federal troops marched from Louisiana. Hayes hoped that the end of Reconstruction would restore the two-party system in the South. But the Democrats won back their solid hold on the South.

Hayes's election

Place of nominating convention	Cincinnati
Ballot on which nominated	7th
Democratic opponent	Samuel J. Tilden
Electoral vote*	185 (Hayes) to 184 (Tilden)
Popular vote	4,288,546 (Tilden) to 4,034,311 (Hayes)
Age at inauguration	54

*For votes by states, see **Electoral College** (table).

Civil service reform. Hayes had announced that he intended to serve only one term as president so he could strive for civil service reform. Hayes based his appointments on merit rather than on the spoils system (see **Spoils system**). He even appointed a Southern Democrat, David M. Key, to his Cabinet. This and other Cabinet appointments angered members of his own party. Hayes also forced the removal of three fellow Republicans from their jobs in the New York Custom House. One of the men was Chester A. Arthur, who became the 21st president (see **Arthur, Chester Alan** [Custom house collector]).

Congress refused to act on the civil service legislation that Hayes proposed, but Hayes was the first president to fight Congress on this issue. His struggle gained wide public support and opened the way for later presidents to make civil service reforms.

Money problems. Because of the depression of the 1870's, many people demanded *cheap money*. Farmers and business owners, for example, believed that putting more money into circulation would raise the prices of their products and thus help them pay off their debts. They wanted the government to issue more paper and silver money even though the money could not be backed by gold in the Treasury. Hayes favored a conservative money policy and resisted their demands.

In 1878, Hayes vetoed the Bland-Allison Act, which required the Treasury to buy and coin between $2 million and $4 million worth of silver a month. Congress passed the bill over his veto. But the Treasury coined only the minimum amount required in an attempt to limit the inflationary effect of putting more money into circulation.

In 1879, the Hayes Administration resumed payment of *specie* (metal coin) for *greenbacks* (paper money issued to finance the Civil War). Secretary of the Treasury John Sherman gathered enough gold in the Treasury to redeem all of the greenbacks that were likely to be brought in. As soon as this became known, no one was anxious to exchange notes for gold. This policy helped restore financial confidence, and business improved.

Life in the White House. Rutherford and Lucy Hayes tried to set a good example for every American family. They quickly gained respect for their hospitality, simplicity, and modesty. They were both concerned about the problem of alcoholism, as were many other people in the country. As a symbol of the temperance cause, the Hayeses stopped the practice of serving alcoholic drinks at the White House, even at formal dinners and receptions. Some critics called Mrs. Hayes "Lemonade Lucy" because of her stance against alcohol.

A typical day in the White House began with morning prayers. Early in the evening, the family often gathered for music and singing. Mrs. Hayes held public receptions almost every evening and welcomed everyone who wished to visit the White House. In 1878, she and President Hayes introduced the custom of Easter egg rolling by children on the White House lawn.

Later years

"Nobody ever left the Presidency with less regret ... than I do," Hayes said when his term ended in 1881. No one seemed sorry that he did not run for a second term. But Hayes believed that the public showed its approval of his Administration by electing James A. Garfield, his friend and political supporter, as president.

Hayes returned to his home at Spiegel Grove, near Fremont, Ohio, and completely withdrew from politics. He devoted himself to philanthropic work in education, prison reform, Christianity, and veterans' affairs.

Mrs. Hayes died in June 1889. Hayes became ill while visiting friends in Cleveland in January 1893. His friends urged him to remain in bed. But Hayes insisted on returning home, saying: "I would rather die at Spiegel Grove than to live anywhere else." He died on Jan. 17, 1893, and was buried in Fremont. Spiegel Grove is now open to the public. It includes the Rutherford B. Hayes Library and Museum. H. Wayne Morgan

Related articles in *World Book* include:

Arthur, Chester Alan
Civil service
Ohio (Places to visit)
President of the United States
Sherman, John
Tilden, Samuel J.

Outline

I. Early life
- A. Education
- B. Lawyer
- C. Hayes's family
- D. Soldier

II. Political career
- A. Congressman
- B. Governor
- C. Campaign of 1876
- D. The election dispute

III. Hayes's Administration (1877-1881)
- A. The end of Reconstruction
- B. Civil service reform
- C. Money problems
- D. Life in the White House

IV. Later years

Questions

What were Hayes's outstanding personal qualities?
How did Hayes influence future civil service laws?
Why did the Republicans turn to Hayes as their presidential candidate in 1876?
How did Congress settle the dispute that resulted from the 1876 election?
What did Hayes expect to accomplish by ending Reconstruction? What actually happened?

Additional resources

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Hoogenboom, Ari. *Rutherford B. Hayes.* Univ. Pr. of Kans., 1995.
Kent, Zachary. *Rutherford B. Hayes.* Childrens Pr., 1989. Younger readers.

Vice president and Cabinet

Vice president	*William A. Wheeler
Secretary of state	*William M. Evarts
Secretary of the treasury	*John Sherman
Secretary of war	George W. McCrary Alexander Ramsey (1879)
Attorney general	Charles Devens
Postmaster general	David M. Key Horace Maynard (1880)
Secretary of the Navy	Richard W. Thompson Alexander Ramsey (1880) Nathan Goff, Jr. (1881)
Secretary of the interior	*Carl Schurz

*Has a separate biography in *World Book*.

Haymarket Riot took place during a labor protest rally in Haymarket Square in Chicago on May 4, 1886. The rioting occurred after someone threw a bomb that fatally wounded seven policemen and one civilian. In the rioting, the police and the crowd exchanged gunfire, and many police officers and spectators were wounded. The Haymarket Riot increased antilabor feelings and

weakened the radical element in American labor. It also strengthened the movement toward "pure and simple" unionism that condemned violence.

The riot occurred during a time when thousands of workers across the country were periodically on strike. It developed from a fight between strikers and strikebreakers on May 3, 1886, at an industrial plant in Chicago. Several workers were killed or wounded during the fight, leading some angry labor leaders to call for armed action by workers and a rally in Haymarket Square the next day. These leaders were *anarchists*—that is, people who wanted to abolish government authority. When police tried to break up the rally, an unknown person threw the bomb. A riot followed.

On Aug. 20, 1886, eight anarchists were convicted of conspiracy against the police. Although they were never found guilty of throwing the bomb or of causing the deaths, seven were sentenced to death and the eighth to prison. In 1887, four of the seven men were hanged, one committed suicide, and the remaining two were sentenced to prison again. In 1893, the three survivors were pardoned by Governor John P. Altgeld of Illinois, who declared that the evidence had been insufficient to support the charges. James G. Scoville

Hayne, Robert Young (1791-1839), was an American statesman and defender of states' rights. He represented South Carolina in the United States Senate from 1823 to 1832. In a famous Senate debate with Daniel Webster in 1830, Hayne said a state had the right to nullify a federal law (see **Nullification; States' rights**). He argued that the states had created the Constitution, and thus could limit the federal government's powers. When South Carolina nullified the U.S. tariff laws in 1832, he resigned from the Senate to become governor. He opposed President Andrew Jackson in the nullification crisis (see **Jackson, Andrew** [The nullification crisis]). Hayne was born in Colleton County, South Carolina. James C. Curtis

Haynes, Elwood (1857-1925), an American automobile inventor and manufacturer, designed one of the first successful automobiles. The vehicle was built for him by Elmer and Edgar Apperson in Kokomo, Indiana, and was completed in 1894. It is now exhibited in the Smithsonian Institution. Haynes's inventions included carburetors and mufflers. He also created a number of alloys, including a cobalt alloy called *Stellite* in 1907, and he contributed to the development of stainless steel. Haynes was born in Portland, Indiana. Joel Webb Eastman

Hazardous wastes are chemicals and chemical by-products that can endanger human health or pollute the environment. Each year, the world's factories and other sources produce billions of tons of wastes. A little more than 1 percent is hazardous. Industrialized countries produce about 90 percent of hazardous wastes.

In the United States, hazardous wastes are defined by the Resource Conservation and Recovery act of 1976 and its 1984 amendments. Waste is declared hazardous if it *corrodes* (wears away) other materials; explodes; is easily ignited; reacts strongly with water; is unstable to heat or shock; or is poisonous. Poisonous wastes are commonly called *toxic wastes*. The law also covers radioactive wastes that occur as by-products of mining operations or as a result of the use of radioactive substances in medical procedures. Radioactive wastes from commercial power plants and other nonmilitary sources are controlled by the Nuclear Regulatory Commission (see **Nuclear energy** [Wastes and waste disposal]). The Department of Energy controls the disposal of radioactive wastes from military sources.

Producers of hazardous wastes include industries, hospitals, laboratories, and other establishments. Factories, especially chemical plants, account for most of the wastes. Nearly all manufacturing results in a small amount of hazardous waste. For example, making plastics yields harmful *organic compounds* (substances containing carbon). Oil refining produces potentially harmful acids, ammonia, and *sludge* (muddy deposits), which may contain chemicals or heavy metals.

Effects of hazardous wastes. Harmful chemicals can pollute *ground water*—that is, water beneath the land's surface. Most rural areas and many cities depend on ground water for their drinking supplies. Some hazardous wastes have also polluted rivers or lakes, killing fish and water plants and endangering water supplies.

Certain wastes can contaminate food and thus poison people or animals. Toxic wastes could poison people or animals through touch or smell. Certain wastes may pollute the air or create a fire hazard.

Disposal of hazardous wastes. Many industries safely dispose of hazardous waste. One disposal method, called *landfilling*, involves storing harmful substances underground. A landfill must have a double lining of *nonporous* substances, such as clay and plastic, through which liquid cannot pass. Some industries recycle their hazardous wastes or use the wastes of other industries as raw materials. Another disposal method, called *bioremediation*, involves the use of bacteria that break down certain wastes, producing harmless substances. Also, burning some hazardous organic compounds at high temperatures makes them harmless.

The Resource Conservation and Recovery Act concerns the reduction, safe management, and disposal of hazardous wastes in the United States. It particularly encourages recycling such wastes, if possible, to recover useful materials. The Comprehensive Environmental Response, Compensation, and Liability Act of 1980, also called "Superfund," has provided billions of dollars to clean up unsafe dump sites. Federal law requires state and local governments to have emergency plans for responding to accidental releases of toxic wastes. The law also requires businesses to reveal hazardous wastes present at their facilities. Melody J. Hunt

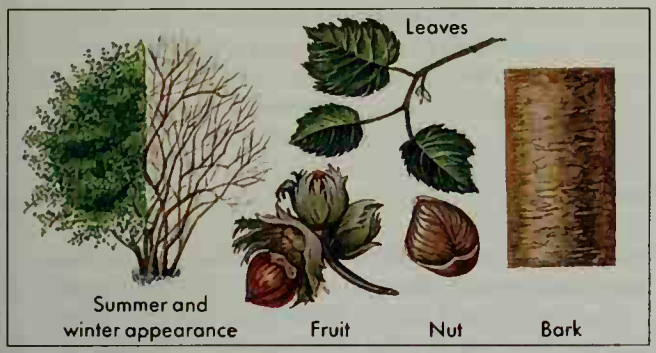
See also **Environmental pollution** (Hazardous waste).

Hazel is any one of about 15 trees and shrubs that grow in the temperate climates of Asia, Europe, and North America. Two hazels are native to the United States—the *beaked hazel* and the *American hazel*. Hazel is often called *filbert* or *cobnut*, as are the edible nuts it produces. Most hazels cultivated for nuts grow in southern Europe and the Northwestern United States.

Hazels have large, oval leaves with toothed edges. They turn yellow in the autumn. The plants bear male and female flowers. The male flowers are tassellike clusters called *catkins* (see **Catkin**). The female blossoms grow on separate twigs. They are small and hard to see.

Hazels furnish valuable cover and food for wildlife. A species with purple leaves and another with twisted branches are grown as ornamentals.

In ancient times, many people believed that a forked



WORLD BOOK illustration by Chris Skilton

The hazel tree produces light-brown nuts that are good to eat. Hazels have large, oval leaves with toothed edges.

hazel twig had supernatural powers. Stories tell how *divining rods* of hazel can be used to find water or minerals underground. *Witch hazel* is not in the group of true hazels. But ancient peoples thought it had many magic powers (see **Witch hazel**). Richard A. Jaynes

Scientific classification. Hazels belong to the birch family, Betulaceae.

Hazlitt, William (1778-1830), was one of the best essayists and critics in English literature. His critical essays were sensitive and analytical. They were marked by enthusiasm and the pure enjoyment that Hazlitt felt in describing the effect of a literary work. He discussed poets, dramatists, essayists, and novelists of his own and earlier times. His essays were collected in *Characters of Shakespeare's Plays* (1817), *English Poets* (1818-1819), *English Comic Writers* (1819), and *A View of the English Stage* (1818-1821). See **Essay** (Formal essays).

The cornerstone of Hazlitt's thinking and writing was his belief in the human imagination's ability to promote moral behavior. Hazlitt emphasized the "disinterestedness" (or selflessness) of the imagination. Hazlitt's vigorous, informal prose style distinguished his personal essays, which appeared in *Table Talk* (1821-1822). Hazlitt was born in Maidstone. Frederick W. Shilstone

Head is the part of the body that contains the brain, the mouth, and the chief sense organs—the eyes, ears, and nose. Its location depends on where the sense organs can best pick up messages from the environment.

In human beings and animals that walk on two legs, the head is at the top of the body. In four-legged animals, the head is at the front. Some animals, such as starfish, have no head. These animals are sensitive to stimuli in various parts of the body.

The skeleton of the head is called the *skull*. The skull is usually composed of bone. In some animals, such as the shark, it is made of cartilage (see **Cartilage**). The *occipital bone* forms the back of the skull. This bone rests on the spinal column and forms a joint on which the head moves. The skin that covers the top and back of the head is called the *scalp*.

A system of muscles and tendons connects the head to the spinal column, the collarbone, and the shoulder blades. These muscles and tendons control the movement of the head. Muscles in the head are important in the processes of chewing and swallowing. They are responsible for facial expressions, such as smiling or frowning.

At birth, the head is very large in relation to the rest of the body. It measures about a fourth of the body length. By adulthood, it is only about an eighth of the body length. A larger skull does not necessarily mean greater intelligence. Charles W. Cummings

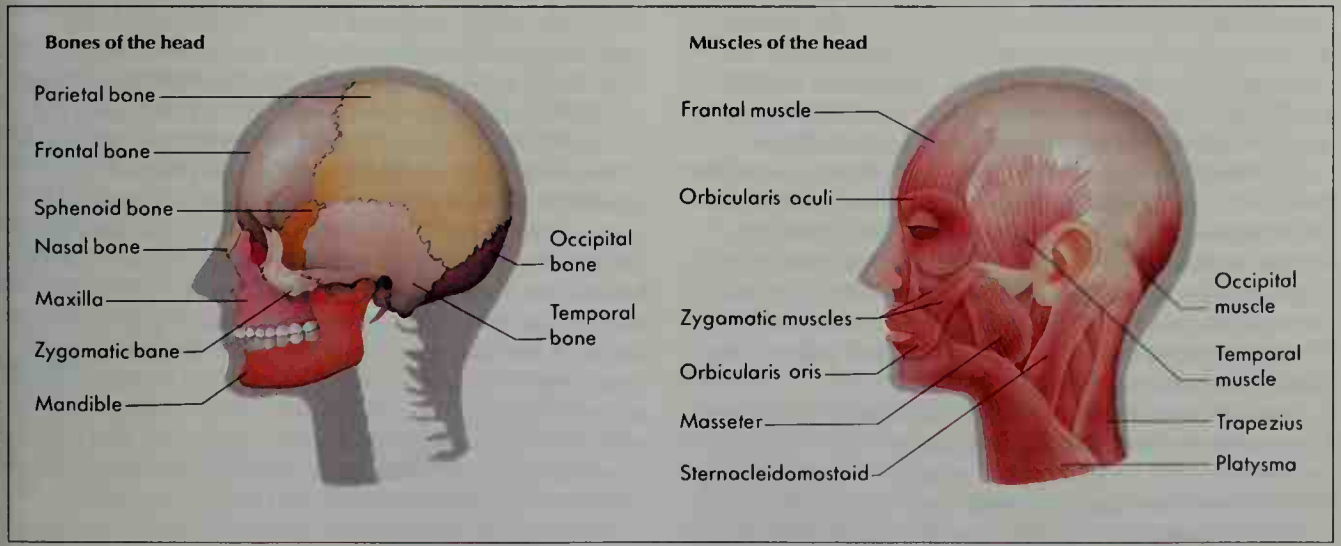
Related articles in *World Book*. See the Trans-Vision three-dimensional picture with **Human body**. See also:

Brain	Face	Phrenology	Skull
Ear	Mouth	Sinus	Tongue
Eye	Nose		

Head lice are small flat, wingless, bloodsucking insects that live almost exclusively on hairs on the human head. One individual insect is called a *head louse*. Mature females lay tiny, pearly eggs called *nits* that they "glue" firmly to the base of individual hairs. Both adult lice and nits can be detected by careful inspection, but they are not easy to see. Head lice rarely transmit dis-

Anatomy of the head The bony frame of the head, *left*, is called the skull. Skull bones form a protective case around the brain and serve as a point of attachment for the muscles of the head. These muscles, *right*, play an important role in chewing and swallowing, and they are responsible for facial expressions.

WORLD BOOK illustrations by Leonard Morgan



eases. But their bites can cause discomfort and intense itching, and people find their presence alarming.

Head lice usually spread from one person to another by direct head-to-head contact. Sometimes, the lice may travel on hairbrushes, hats, scarves, or other objects. Infestation can happen to anyone, but it is more common among young children than among teen-agers or adults. Getting head lice has no relationship to cleanliness, wealth, or the texture or other characteristics of hair.

Some reports suggest that the number of cases of head lice has increased since the 1970's. Many experts think that an increase may have occurred because the lice developed resistance to chemicals in shampoos and rinses commonly used to kill them. Infestations can also be reduced or eliminated by *nit-picking*—that is, physically removing adults and nits by hand or with special fine-toothed combs. May R. Berenbaum

Scientific classification. Head lice are in the genus *Pediculus*. Many experts classify the head louse as the subspecies *Pediculus humanus capitis*, but some consider it the species *P. capitis*.

Head Start is a United States government program that provides educational, social, and health services to young children from the nation's lowest-income families. The program also provides assistance for the children's families. Head Start was founded on the idea that good early childhood experiences provide much of the basis for later success and well-being. It aims to offer children from poor families the same quality of experiences available to children from wealthier homes.

Head Start began in 1965 as a summer project in President Lyndon B. Johnson's War on Poverty. The program quickly expanded to run throughout the school year and serve hundreds of thousands of children annually. Head Start centers now operate in almost every county in all 50 states. Head Start is conducted by the Administration for Children and Families within the U.S. Department of Health and Human Services.

Head Start serves a diverse group of preschoolers from 3 to 5 years old, including children with disabilities. Head Start centers recruit and enroll children from the community. Each center's program is designed for the ethnic and cultural characteristics of its community.

The most important areas of the Head Start program focus on education, health, family involvement, and social services. The educational aspect provides learning experiences designed to stimulate emotional, intellectual, physical, and social growth. Health services include immunizations and other medical, dental, and mental health care. Another health service is a nutritional program, which offers healthy meals and snacks daily.

The families of children in the program play an important role in its operation. Staff members make home visits to help families identify their needs and strengths and to explain how learning can take place at home. Parents serve on policy councils and committees and are encouraged to work in the centers as volunteers. Through programs financed by Head Start, parents can qualify as classroom aides or teachers.

Head Start provides counseling and other social services as needed to children and their families. Additional services include referring families to other community resources and providing emergency assistance.

In 1994, Congress created a companion program called Early Head Start that serves low-income pregnant women and children under 3 years old. Much research indicates that the first three years of a child's life are especially critical for growth and development. Early Head Start combines with Head Start to lay the groundwork for future health and success. Mary Renck Jalongo

Headache is a pain in the head. Almost all people experience a headache at some time in their lives. Although most headaches do not indicate serious illness, they are a major cause of suffering and missed work.

Headaches rank as one of the most common reasons that people consult a doctor. However, most headaches do not cause any abnormalities that a doctor can detect in an office examination. Doctors evaluate headaches by considering such symptoms as how severe pain is, where it occurs, and how long it lasts. When diagnosing headaches, most doctors first decide whether a headache is (1) *primary* or (2) *secondary*.

Primary headache is a condition in which head pain is usually the basic medical problem. Doctors perform a thorough physical examination to rule out underlying causes of head pain, which are discussed in the next section under *Secondary headache*. Treatment of primary headaches is aimed at relieving pain or preventing future headaches. The most common type of primary headache is *tension-type headache*. Doctors once thought that *tension* (tightness) in muscles of the head and neck caused these headaches. Most scientific studies have not found tension in these muscles. But many patients report that these muscles feel tight, even though such tension cannot be scientifically confirmed. Although symptoms vary, most patients with tension-type headache experience steady, dull pain. The pain usually occurs in the front of the head, the temples, the back of the neck, or in a combination of these regions.

Treatment of tension-type headaches depends on how often they happen. For occasional headaches, doctors usually recommend rest, pain medications, or, sometimes, muscle relaxants.

For frequent tension-type headaches, doctors usually avoid prescribing pain medication. Repeated use of pain preparations can lead to changes in the way the brain interprets pain signals. These changes can cause *rebound headaches*, in which pain returns repeatedly when the effects of pain medicine wear off. Pain medicine may thus help create a cycle of continuing headaches and dependence on drugs. Doctors generally treat frequent tension headaches and other chronic pain with drugs called *antidepressants* (see **Antidepressant**).

Another type of primary headache is a *migraine*. For more information about such headaches, see **Migraine**.

Secondary headache is a symptom of some other underlying illness. Treating such headaches often requires correcting the underlying condition as well as relieving head pain. One of the most common secondary headaches is *sinus headache*. Sinus headache results from congestion of the *sinuses*, small air-filled spaces in the skull near the nose. The location of headache pain from sinus congestion varies, depending on which sinus is involved. Sinus headaches are usually treated with rest, medicines that relieve nasal congestion, and pain medication. Doctors may also prescribe antibiotics to treat sinus headaches caused by bacterial infections.

Secondary headaches may also result from serious ill-

nesses such as *meningitis,* an infection of the membranes covering the brain and spinal cord. *Stroke,* a blood clot or bleeding in the brain, is another major cause of secondary headaches. Michael B. Stevens

Related articles in *World Book* include:

Allergy	Concussion	Migraine
Analgesic	Ibuprofen	Stroke
Aspirin	Meningitis	Whiplash

Additional resources

Constantine, Lynne M., and Scott, Suzanne. *Migraine.* Dell, 1994.
Sacks, Oliver W. *Migraine.* Rev. ed. Vintage Bks., 1999.

Headhunter is a person who cuts off the head of a dead enemy to keep as a trophy. Headhunting was usually a part of intertribal warfare. The heads were often used in rituals. Headhunters performed ceremonies after a hunt to prevent revenge by spirits of the dead.

There is evidence that the Neanderthals, a prehistoric group, removed heads for ritual purposes. Headhunting was formerly practiced in many parts of the world, particularly in Malaysia, Melanesia, and South America. In South America, the Jívaro Indians of Ecuador removed the skull and applied hot sand to shrink the skin of the head to a small size. The avenging soul of the dead person was then believed to be safely trapped inside. Today, headhunting is forbidden nearly everywhere.

Jennie Keith

Headphones are a device used for listening in private to various types of equipment that reproduce sound. Such equipment includes compact disc players, phonographs, radios, tape recorders, and telephones. Headphones typically provide one earpiece for each ear and can reproduce stereophonic sound (see **Stereophonic sound system** [Headphones]). Headphones are either *circumaural* (almost airtight) or *supra-aural* (relatively loose-fitting). Headphones are sometimes called earphones.

All headphones receive electric waves from some type of sound-reproduction equipment and convert the waves into sound. Thus, headphones serve as miniature speakers (see **Speaker**). Various kinds of headphones work by means of different mechanisms. But nearly all such mechanisms function in much the same way.

Most headphones have three main parts: (1) a coil of wire called a *voice coil,* (2) a cone-shaped piece of paper or plastic called a *diaphragm,* and (3) a permanent magnet. The voice coil is attached to the diaphragm. The permanent magnet is near the voice coil. When electric waves pass through the voice coil, they produce varying magnetic forces in the coil. These forces drive the coil alternately toward and away from the permanent magnet. The coil moves back and forth so rapidly that it vibrates. The vibrations of the coil create vibrations in the diaphragm. The diaphragm's vibrations, in turn, produce vibrations in the air, which the ear hears as sound.

The famous American inventor Alexander Graham Bell made the first earphone in 1876. It formed part of the first telephone. Stanley R. Alten

See also **Telephone** (The receiver; illustration).

Health is a state of physical, mental, and social well-being. It involves more than just the absence of disease. A truly healthy person not only feels good physically but also has a realistic outlook on life and gets along well with other people. Good health enables people to enjoy life and have the opportunity to achieve their goals.

To achieve and maintain good health, people must have basic knowledge about the human body and how it functions. Only then can they determine what will or what will not help or hurt their health. Learning about health should be a part of everyone's education.

Society as a whole benefits from people's good health just as individuals do. For that reason, many government and voluntary agencies strive to preserve and improve the health of all people. The World Health Organization (WHO), an agency of the United Nations, works to promote better health throughout the world.

Elements of physical health

All parts of the body must work together properly to maintain physical health. A person who is in good physical condition has the strength and energy to enjoy an active life and withstand the stresses of daily life. The various practices that help maintain health include proper nutrition, exercise, rest and sleep, cleanliness, and regular medical and dental care.

Nutrition. A balanced diet provides all the food substances needed by the body for healthy growth and development. Nutritionists use the term *nutrients* for these substances and classify them into six main groups: (1) water, (2) carbohydrates, (3) fats, (4) proteins, (5) vitamins, and (6) minerals. The National Academy of Sciences maintains a list of Recommended Dietary Allowances (RDA), which provides information on how much of each nutrient a person needs each day. Dietary fiber is also important to health, though no RDA has been established for it.

A balanced diet consists of a wide variety of foods. Fruits and vegetables provide important vitamins and minerals. Meat, poultry, fish, eggs, dried beans, some dairy products, and nuts are rich sources of protein. Bread, cereals, and potatoes furnish carbohydrates in addition to vitamins, minerals, and fiber.

Good nutrition also includes eating the proper amount of food each day. Overeating can lead to excess weight, which strains the heart and increases the risk of getting such illnesses as diabetes and heart disease.

Many people try to lose weight quickly by following fad diets. But these diets can be dangerous, especially if used over a long period. The safest way to lose weight is to consult a physician or dietitian and follow the program he or she prescribes. Most programs combine moderate daily exercise with a balanced diet that contains a limited number of calories.

Exercise helps keep the body healthy and fit. Vigorous exercise strengthens muscles and improves the function of the circulatory and respiratory systems. Physical fitness benefits both physical and mental health and helps the body withstand stress.

To achieve fitness, a person should start an exercise program slowly and build it up gradually to a level that maintains a healthy heart and strong muscles. Engaging several times a week in such popular activities as bicycling, jogging, and swimming—and even taking long, brisk walks—can furnish the vigorous exercise that is necessary for fitness. Participating in golf, bowling, or some other sport only once or twice a week cannot develop and maintain fitness.

Rest and sleep help overcome fatigue and restore energy to the body. Everyone needs rest and sleep, but

the amount required differs for each individual. Most adults sleep from 7 to 8 $\frac{1}{2}$ hours a night, though some need less sleep and others need more. Young children may need more sleep at night plus a daytime nap.

Nearly everyone has trouble falling asleep occasionally. However, frequent *insomnia* (inability to sleep naturally) can indicate various physical or emotional disorders. Therefore, it is best to consult a physician about any frequent sleep problem. Some people take sleeping pills to counteract insomnia. But such drugs can make sleeping problems worse, and they should not be used without a doctor's prescription.

Rest and relaxation are as important as sleep. After strenuous work or exercise, a person may need a period of total rest. At other times, only relaxation or a change of pace is necessary. Any activity that differs from the normal routine of work or study can be relaxing. Pleasurable and relaxing activities help the body shed tension and remain robust. If rest and relaxation do not relieve fatigue and tension, the individual may have a physical or emotional problem.

Cleanliness controls the growth of bacteria and other germs that can cause disease. A regular bath or shower keeps the body free from dirt and odor. In addition, it helps prevent skin infections that may develop if bacteria grow and multiply on the skin. The hair should also be washed regularly. Daily dental care is another important part of personal cleanliness. Brushing the teeth properly and using dental floss keep the teeth clean and help prevent decay and gum disease.

Medical and dental care. Regular checkups by a physician and dentist play an important role in safeguarding health. Doctors recommend that people seek medical care at the first sign of illness. Early care can result in a quicker cure and lower medical costs. Treating oneself for more than a day or two is unwise unless the condition improves steadily. A physician or medical clinic has the knowledge and special equipment to provide accurate diagnosis and treatment.

Prevention of disease is an important part of medical care. Children should visit a doctor or clinic to receive immunization against chickenpox, diphtheria, measles, mumps, polio, rubella, tetanus, whooping cough, meningitis caused by the bacterium *Haemophilus influenzae* type b, and hepatitis B. See **Immunization**.

Elements of mental health

Physical health and mental health are closely connected. Mental health plays an important role in both the way people behave and the way they feel. Emotionally healthy individuals accept themselves as they are—with all their weaknesses as well as their strengths. They remain in contact with reality and can deal with stress and frustration. They also act independently of outside influences and show genuine concern for others.

Emotional development. Experiences during childhood strongly influence a person's mental health throughout life. An infant is completely helpless at birth and must depend on its parents for all its needs. Children remain dependent for many years, but they slowly mature and learn to do things for themselves. They make many mistakes during this long period of growth and maturation. Through these errors, they learn certain guidelines for relating to other people. Thus, children develop the knowledge necessary to deal with difficult situations in life. This knowledge helps them maintain good mental health throughout life.

Emotional development does not end when a person reaches adulthood. Similarly, an individual's mental health continues to change from time to time. These changes result from daily circumstances that cause either pleasure or pain for the person.

Handling stress is essential for avoiding both mental and physical illness. Feelings of stress are the body's response to any threatening or unfamiliar situation. Most severe stress results from such serious events as a divorce or loss of a job. However, stress can occur even in pleasant situations, such as watching a football game or waiting for a loved one to return from a trip. If not handled properly, stress can lead to physical or emotional illness. It may produce only mild symptoms, such as a cough, a headache, or a rash. But severe and prolonged stress can contribute to serious health problems, including high blood pressure and stomach ulcers.

No one can avoid stress, but a person can do certain things to help lessen the danger of becoming ill from it. Regular exercise and sufficient sleep strengthen the body's resistance to stress. Everyone should learn to relax by resting, taking a walk, meditating, working with a hobby, or by any other method that he or she finds successful. When serious stress occurs, a person should determine the source of the stress and try to eliminate or diminish it. Discussing a problem with a friend, relative, or some other person may also help relieve stress. If these measures are not helpful enough, a mental health professional should be consulted.

Social relationships have an important influence on mental health. Close personal relationships with friends and relatives provide opportunities for communication, sharing, and emotional growth. Such relationships also can provide strength and support for dealing with challenging situations or personal problems.

An individual's entire social environment also affects his or her mental health. Such social problems as poverty, racism, and overcrowding contribute to situations that influence emotional health. As a result, social and economic changes are needed to help reduce the rate of some types of mental illness.

Health hazards

The nature of health problems in the United States and Canada changed dramatically during the 1900's. Until then, most people died from infectious diseases, such as diphtheria or pneumonia. Today, however, infectious diseases are no longer the main killers in the United States, Canada, and other industrialized nations. Improved sanitation, immunization programs, and the development of antibiotic drugs have brought these diseases under control. Today, health specialists are chiefly concerned with diseases related to the aging process, unhealthy lifestyles, and environmental hazards.

Tobacco, alcohol, and drug abuse. According to the U.S. Department of Health and Human Services (HHS), cigarette smoking is the principal cause of unnecessary and preventable illness and early death. Heart disease, lung cancer and other lung diseases, and several other types of cancer occur at a much higher rate among smokers than among nonsmokers.

Many people use various drugs in an effort to solve their problems or to improve their alertness, mood, or self-confidence. But regular use of alcohol, narcotics, or sedatives can cause addiction and serious damage to the body. People may become psychologically dependent on a wide variety of other drugs, including amphetamines, cocaine, LSD, marijuana, and tranquilizers. These individuals may harm themselves further by neglecting their health and nutrition. Also, drugs can distort a person's judgment and so increase the risk of accidents.

Alcohol is one of the most widely abused drugs in the United States. Experts estimate that from 10 million to 20 million people suffer from alcoholism. There is no cure, but the condition can be treated. An alcoholic who gives up drinking can return to a healthy, productive life.

Environmental health hazards caused by modern technology can produce serious problems. Air pollution can worsen the condition of people who suffer from such respiratory diseases as asthma and bronchitis. It may even help cause some diseases, including cancer and emphysema. In some areas, insecticides and industrial wastes contaminate food and water supplies. Excessive noise can also threaten people's health. Noise from airplanes, construction projects, and industrial plants can cause hearing loss as well as emotional damage.

Occupational health hazards threaten the health of many workers. In some cases, substances involved in a person's job may cause long-term damage that appears only after many years. For example, many coal miners develop a lung disease called *pneumoconiosis,* or *black lung,* from inhaling coal dust. Dust also causes lung diseases among workers in the asbestos and cotton industries. Some industrial chemicals, including arsenic and vinyl chloride, cause cancer. People who work with X rays and other forms of radiation also face a health hazard unless proper precautions are used.

Public health

Public health includes all actions taken to maintain and improve the general health of a community. Government health programs provide most public health services. In addition, many voluntary health agencies receive contributions to combat specific diseases, such as cancer and lung disease. These agencies provide medical services, campaign for health legislation, and make important contributions to health education.

In the United States, the Public Health Service administers the government's public health programs. State and local health departments also provide a wide range of services in most communities. For example, they work to prevent and control disease by providing proper sanitation, conducting immunization programs, and enforcing quarantines. They also operate clinics that offer free laboratory tests and other medical services to the public. Another important function of public health agencies is to provide health education to individuals, groups, and organizations. Jane E. Brody

Related articles in *World Book.* See Public health and its list of *Related articles.* See also the following articles:

Biographies

Barton, Clara
Curie, Marie Skłodowska
Dix, Dorothea L.
Fleming, Sir Alexander
Galen
Gorgas, William C.
Hippocrates
Jenner, Edward
Koch, Robert
Lister, Sir Joseph
Metchnikoff, Élie
Nightingale, Florence
Pasteur, Louis
Reed, Walter
Sabin, Albert B.
Salk, Jonas E.
Trudeau, Edward Livingston

Personal health

Alcoholism
Apgar score
Baby
Bath
Child
Cigarette
Circumcision
Diet
Disease
Drug abuse
Fat (Fats and disease)
Fatigue
Food
Growth
Health food
Heat index
Human body
Immune system
Immunization
Nutrition
Physical fitness
Posture
Sauna
Sleep
Smoking
Stress
Tea (Tea and health)
Teeth (Care of the teeth and gums)
Weight control

Organizations

Centers for Disease Control and Prevention
Health, Board of
Health and Human Services, Department of
Health Council, National
National Institutes of Health
Overeaters Anonymous
Public Health Service
UNICEF
World Health Organization

Other related articles

Careers (Health care)
Colonial life in America (Health and medicine)
Environmental pollution
Holistic medicine
Managed care plans
Medicine
Occupational medicine
Physical education
Pure food and drug laws
Recreation
Safety

Additional resources

Bunch, Bryan. *Handbook of Current Health and Medicine.* Gale Research, 1994.

Collinson, Alan. *Choosing Health.* Raintree Steck Vaughn, 1991. Younger readers.

Larson, David E., ed. *The Mayo Clinic Family Health Book.* 2nd ed. Morrow, 1996.

Health, Board of, is a policy-forming or advisory body that aids the executive branch of a government in operating the health department. Both state and local governments have boards of health.

Duties of a state board may be advisory or regulatory. Some state boards have executive and police powers to enforce public health laws. City and county boards may have similar duties and powers. In some states, all members must be physicians. In others, members must represent all professions concerned with public health. Still others specify representation of the nonprofessional public. Members of state boards may be appointed by the governor or elected by the state medical society. Members of local boards may be appointed by the mayor or council, or elected by the citizens.

The United States does not have a federal board of health. In its place, Congress has authorized the appointment of advisory committees and councils to the U.S. Public Health Service (PHS). The PHS is part of the Department of Health and Human Services. Alan R. Hinman

See also Public Health Service; Sanitation.

Health, National Institutes of. See National Institutes of Health.

Health, Public. See Public health.

Health and Human Services, Department of, is an executive department of the United States government that works to ensure public health and to assist children and families. The secretary of health and human services directs the department and serves in the president's Cabinet. The president appoints the secretary

with the consent of the U.S. Senate. The department is sometimes called HHS.

The department was created in 1953 as the Department of Health, Education, and Welfare. In 1979, Congress passed legislation transferring most education programs from that department to a new Cabinet-level Department of Education. The Department of Health, Education, and Welfare was renamed the Department of Health and Human Services.

Organization. The Department of Health and Human Services has three main divisions: (1) the Public Health Service, (2) the Health Care Financing Administration, and (3) the Administration for Children and Families.

The Public Health Service works to protect and promote physical and mental health. It includes the surgeon general, who helps develop and administer public health policy.

Some of the primary agencies of the Public Health Service are the National Institutes of Health, which conducts and supports research into the causes, prevention, and treatment of diseases; the Food and Drug Administration, which ensures the purity of food, the safety of cosmetics, and the safety and effectiveness of drugs and other medical products; and the Centers for Disease Control and Prevention, which conducts programs to prevent disease and disability.

The Public Health Service also administers programs for the treatment and prevention of drug addiction and mental illness. In addition, it provides health care for American Indians and for people who lack access to, or cannot afford, health care. The Public Health Service also works to protect people from exposure to hazardous substances.

The Health Care Financing Administration administers the Medicare and Medicaid programs. Medicare provides health insurance for people 65 years old and older and for some disabled people. Medicaid provides health care for many people who could not otherwise afford it.

The seal of the Department of Health and Human Services

The Administration for Children and Families administers such programs as Head Start, Job Opportunities and Basic Skills Training (JOBS), Child Support Enforcement, Adoption Assistance, and Foster Care. Other programs are designed to identify, prevent, and treat child abuse.

History. In the 1800's, state and local governments provided most government welfare services. Federal activities in this field began in the 1900's. In 1939, the Federal Security Agency was established to administer major programs in the fields of social security, job placement, education, and public health.

In 1953, the Department of Health, Education, and Welfare (HEW) was established, and all Federal Security Agency functions were transferred to it. These functions included those of the Office of Education, the Public Health Service, and the Social Security Administration. The Social Security Administration administers federal programs to provide retirement, disability, and death benefits.

In 1979, Congress enacted a law that created the Department of Education and moved most education programs to the new department. The following year, HEW was renamed the Department of Health and Human Services. The Administration for Children and Families was formed as part of HHS in 1991. In 1995, the Social Security Administration was separated from the department and made an independent federal agency.

Critically reviewed by the Department of Health and Human Services

Related articles in **World Book** include:

Children and Families, Administration for
Children's Bureau
Consumer Affairs, United States Office of
Flag (picture: Flags of the United States government)
Food and Drug Administration
Head Start
Medicaid
Medicare
National Institute for Occupational Safety and Health
National Institutes of Health
Public Health Service
Social Security Administration
Surgeon General of the United States
Vital statistics (Collecting and publishing vital statistics)

Secretaries of health, education, and welfare

Name	Took office	Under President
* Oveta Culp Hobby	1953	Eisenhower
Marion B. Folsom	1955	Eisenhower
Arthur S. Flemming	1958	Eisenhower
* Abraham A. Ribicoff	1961	Kennedy
Anthony J. Celebrezze	1962	Kennedy, Johnson
* John W. Gardner	1965	Johnson
Wilbur J. Cohen	1968	Johnson
Robert H. Finch	1969	Nixon
* Elliot L. Richardson	1970	Nixon
* Caspar W. Weinberger	1973	Nixon, Ford
F. David Mathews	1975	Ford
* Joseph A. Califano, Jr.	1977	Carter
* Patricia R. Harris	1979	Carter

Secretaries of health and human services

Name	Took office	Under President
* Patricia R. Harris	1979	Carter
Richard S. Schweiker	1981	Reagan
* Margaret M. Heckler	1983	Reagan
Otis R. Bowen	1985	Reagan
* Louis W. Sullivan	1989	G. H. W. Bush
Donna E. Shalala	1993	Clinton
Tommy G. Thompson	2001	G. W. Bush

*Has a separate biography in *World Book*

Health care plans. See Insurance (Private health insurance); Managed care plans.

Health Council, National, founded in 1920, is a private, nonprofit association of leading voluntary, professional, business, governmental, and nonprofit health organizations in the United States. The council has over 120 member groups. Its chief programs aim (1) to encourage Americans to maintain and improve their health and (2) to educate Americans on how to use health resources wisely.

The National Health Council provides a meeting ground between public and private health organizations. It sponsors the National Health Forum, produces publications on health issues, and promotes aware-

ness of health career opportunities. Council headquarters are in Washington, D.C.

Critically reviewed by the National Health Council

Health, Education, and Welfare, Department of. See Health and Human Services, Department of.

Health food is a term used to describe a variety of foods and products that some people believe will improve or preserve their health. Many supermarkets have a health food section, and some stores specialize entirely in such products. Popular health foods include bran, *tofu* (soybean curd), yogurt, and foods high in specific nutrients thought to have particular health benefits.

Medical and nutritional research have shown that numerous foods promote well-being. However, promises about health foods can be exaggerated or even false, such as claims to prevent aging or cure disease. The governments of many countries regulate the use of such words as *organic, natural,* and *healthy* on food labels and in advertisements to reduce deceptive claims.

Types of health foods. Some consumers who have concerns about the safety of *additives* (chemicals added to foods), pesticides, and highly processed food often select *organic* or *natural* foods. Farmers grow organic foods without using synthetic fertilizers or pesticides. Natural foods undergo little or no *processing* (chemical alteration or treatment), so they keep their natural nutritious qualities. They generally lack such additives as artificial colors and *preservatives,* which prevent spoilage.

Naturally occurring or specially created foods that have been scientifically shown to benefit health are sometimes called *functional foods. Designer foods* are functional foods developed through crossbreeding or genetic engineering. For example, scientists have "designed" a type of rice rich in *beta-carotene,* a healthful nutrient. Packaged products to which the manufacturer has added nutrients are also called designer foods.

Retailers often sell *dietary supplements,* such as vitamins and minerals, as a health food. Vitamins may be made from natural sources or artificially produced. Both types are chemically identical and equally effective. But natural supplements, like health foods, often cost more.

History. People have long recognized the relationship between a balanced diet and good health. In the early 1800's, the American dietary reformer Sylvester Graham lectured on the benefits of eating whole grain flours. The American cereal manufacturers John H. Kellogg, his brother Will Kellogg, and Charles W. Post promoted Graham's ideas. They introduced ready-to-eat breakfast cereals, which they advertised as health food. In the 1970's, whole grain foods gained in popularity after Denis P. Burkitt, a British physician, suggested that the relatively low occurrence of digestive problems among people in Africa may result from their high-fiber diet. Richard C. Baybutt

See also Dietary supplement; Food preservation; Nutrition; Vitamin.

Health insurance. See Insurance (Private health insurance); Blue Cross and Blue Shield; Managed care plans; Medicine (Providing medical care; Financing advanced medical care).

Health insurance, National, refers to a government program that pays the health care expenses of almost all of a country's people. Such programs are financed by taxes and are sometimes called *NHI.* In nations with national health insurance, the government determines the medical services the program will cover as well as the prices it will pay for those services. The United States is one of the few industrialized countries without national health insurance.

In the United States, there has been much public debate since the early 1900's over whether the federal government should adopt national health insurance. Modern medical treatment can be extremely expensive for a serious injury or illness. Many people cannot afford such treatment without health insurance. In the United States, most people have *private* (nongovernment) health insurance, which they buy directly from an insurance company or acquire through their employer. However, Americans who favor the adoption of NHI point out that many individuals, especially the unemployed, cannot afford private health insurance.

Americans opposed to NHI feel it would give the government too much control over the field of medicine. They also think it would result in higher taxes and worse medical care. Many believe Americans could get more complete insurance coverage without as much government control—or as much tax money—as NHI would require. Opponents of NHI often refer to it as *socialized medicine.*

Although the United States does not have national health insurance, the federal government pays about 35 percent of the total medical expenses of the country. State and local governments pay an additional 10 percent. Health insurance is provided to many poor people under a federal-state program called Medicaid. Most people age 65 or older get health insurance from the federal government under a program called Medicare.

In Canada, a national health insurance program gradually went into effect between 1955 and 1971. Under the Canadian program, each of the country's provinces provides health insurance to its own residents. The federal government pays part of the costs. The provinces must meet standards established by the federal government. These standards include coverage for all of the province's residents, broad coverage of medically necessary services, and reimbursement for medical expenses incurred outside the province. Mark J. Browne

See also Medicine (Providing medical care; Financing advanced medical care).

Additional resources

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Maioni, Antonia. *Parting at the Crossroads: The Emergence of Health Insurance in the United States and Canada.* Princeton, 1998.

Roemer, Milton I. *National Health Systems of the World.* 2 vols. Oxford, 1991, 1993.

Health maintenance organization. See Managed care plans.

Healy, James Augustine (1830-1900), was the first African American bishop of the Roman Catholic Church. Pope Pius IX appointed him Bishop of Portland, Maine, in 1875. Healy's diocese consisted of the entire state of Maine. It also included New Hampshire until 1884, when that state became a separate diocese. In Maine, Healy served as religious leader of thousands of people, almost all of whom were white.

Healy was born on April 6, 1830, near Macon, Geor-

gia. His father was a white plantation owner, and his mother was a slave. Healy graduated from the College of the Holy Cross in 1849 and then studied for the priesthood in Montreal and Paris. In 1854, he became the first black American to be ordained a Catholic priest. He served in Boston until 1875, first as the bishop's secretary, then as a parish priest. Edgar Allan Toppin

Heaney, *HEE nee,* **Seamus,** *SHAY muhs* (1939-), an Irish poet, won the 1995 Nobel Prize for literature. His poetry shows a powerful devotion to the earth, particularly to the landscape and soil of his native Northern Ireland. But Heaney is equally dedicated to language. He makes the words of his poems assume the qualities he finds in the physical world.

Many of Heaney's poems portray the intimate details of the Irish countryside and its trees, fields, and bogs. Some of his poems describe ancient corpses discovered in peat bogs, preserved by chemicals in the soil. For Heaney, these figures symbolize the power of the Irish land to preserve the memories and traditions of its people. Several of his poems draw upon ancient Irish legends about a hero named Sweeney, who has been preserved for centuries in the Irish imagination.

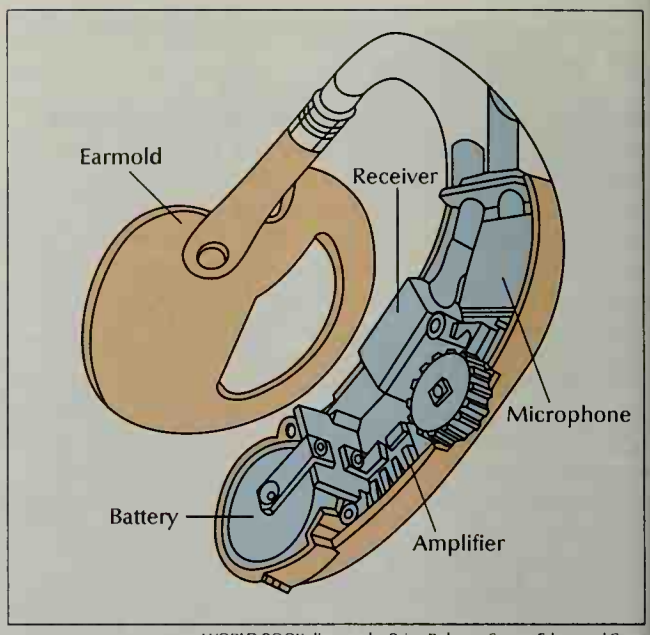
Heaney's poetry is also deeply concerned with the political turmoil and violence in present-day Northern Ireland. Many of his poems deal with the ongoing conflict between the Irish Republican Army and the United Kingdom over Irish independence. Heaney believes that a poet must keep a distance from politics, refusing to take sides. He believes that his task is to record as forcefully as he can the conflict's effects on individuals, especially the suffering and the moral confusion it causes them.

Heaney was born on April 13, 1939, on a farm in County Derry, Northern Ireland. Heaney selected poems from 10 books of his poetry for the collection *Opened Ground: Selected Poems, 1966-1996* (1998). He released another collection, *Electric Light,* in 2001. His lectures on poetry were published in *The Redress of Poetry* (1995). In 1999, Heaney completed an award-winning translation of the medieval English epic poem *Beowulf.*

Roger Gilbert

Hearing. See Ear (The sense of hearing).

Hearing aid is a device that amplifies sound. Many hearing-impaired people depend on the device. Hearing aids may enable them to do such things as use a telephone, enjoy music, and more easily understand conversation. Millions of hearing aids are sold each year. Most hearing aids are sold to people over 65 years old.



WORLD BOOK diagram by Brian Robson, Steven Edsey and Sons; critically reviewed by Dyn-Aura Engineering Laboratories

The main parts of a hearing aid are shown in this diagram of a behind-the-ear aid. They are (1) a microphone, (2) an amplifier, (3) a receiver, (4) a battery, and (5) an earmold.

Types of hearing aids. There are two types of hearing aids, *air-conduction aids* and *bone-conduction aids.* An air-conduction aid amplifies sound and brings it directly into the ear. Most people who use hearing aids have this type of aid. However, in some people, sound cannot be transmitted through the outer or middle ear. These people often use a bone-conduction aid, which brings sound waves to the bony part of the head behind the ear. The bone transmits the vibrations to the auditory nerves of the cochlea. Hearing is possible when these nerves are stimulated.

The parts of a hearing aid. Modern hearing aids have five major parts: (1) a microphone, (2) an amplifier, (3) a receiver or earphone, (4) a battery, and (5) an earmold that fits in the ear. The microphone picks up sound and changes it into electrical impulses or signals. The amplifier increases the strength of the signal. The receiver then changes the signal back to amplified sound that can be understood by the user. The battery supplies power for the operation of the aid, and the earmold secures the receiver in the ear canal.

History. Hearing aids have been used since the 1600's. The first hearing aids used a horn-shaped device to gather sound and funnel it into the ear. Electric hearing aids appeared about 1900. They were quite large and provided little help to people with severe hearing loss. Acoustic fans, sometimes called *hearing fans,* also appeared about 1900. These devices were fan-shaped bone-conduction instruments made of a thin, hard rubber called *vulcanite.* A user held the edge of the acoustic fan between the teeth and bent the device toward the sound. The sound vibrations traveled from the teeth to the jawbone, the skull, and finally the auditory nerves.

Electronic hearing aids first appeared about 1920. The first of these devices were *vacuum-tube aids.* At first, these aids were bulky and inconvenient to use. By 1930,

Phonic Ear Inc. Beltone Electronics

Modern hearing aids serve the wearer's individual needs. An all-in-the-ear hearing aid, *left,* corrects moderate hearing loss. A behind-the-ear model, *right,* is for more serious hearing loss.

however, wearable vacuum-tube aids appeared. These aids used a crystal microphone, a vacuum-tube amplifier, and two batteries. They were more compact and easier to carry and conceal than earlier models. These factors helped many hearing-impaired people overcome their reluctance to use hearing aids.

Another type of electronic hearing aid, the *transistor hearing aid,* appeared in the early 1950's. These hearing aids are dramatically smaller than vacuum-tube models. They are also less expensive to operate because they usually require only one small battery. For these reasons, transistor hearing aids have completely replaced vacuum-tube models.

Modern transistor hearing aids are made in a wide range of styles and designs. They are very powerful and may be adjusted to a wide range of sound frequencies and levels of amplification. In addition, many transistor hearing aids are small enough to be concealed in the user's ear canal. John B. Christiansen

Hearing dog. See Dog guide.

Hearing loss. See Deafness.

Hearn, Lafcadio (1850-1904), was an American author. His best-known works display a weird imagination and a polished style. Hearn said, "I have pledged myself to the worship of the Odd, the Queer, the Strange, the Exotic, and the Monstrous."

Hearn was born in the Ionian Islands off the west coast of Greece. He moved to the United States at the age of 19 and eventually settled in New Orleans. There he wrote a series of eerie newspaper sketches called "Fantastics." After living for a time in the West Indies and New York City, he moved to Japan in 1890. Hearn became a Japanese citizen and a professor of English literature at the Imperial University of Tokyo.

Hearn wrote many fantastic and supernatural tales. They were collected in such works as *Some Chinese Ghosts* (1887) and *Kwaidan* (1904). His first and best-known novel is *Chita* (1889). Hearn also wrote several books about Japan. Bert Hitchcock

Hearne, Samuel (1745-1792), was an English explorer and fur trader. He was the first white person to journey overland from Hudson Bay to the Arctic Ocean. He reached the Arctic Ocean in July 1771, while exploring for the Hudson's Bay Company. He arrived at Great Slave Lake in northern Canada later that year. Hearne set up the first Hudson's Bay Company inland post in Saskatchewan in 1774. He commanded Fort Prince of Wales in Manitoba from 1775 until the French seized it in 1782. In 1783, Hearne established a post at Churchill, Manitoba. He returned to England in 1787. Hearne was born in London. He joined the Hudson's Bay Company about 1765. John Elgin Foster

Hearst, Phoebe Apperson (1842-1919), an American philanthropist and educator, was a cofounder of the National Congress of Mothers. She and Alice J. M. Birney established the organization in 1897. In 1925, it became the National Congress of Parents and Teachers, the national organization of local parent-teacher associations (PTA's). Hearst was also the first woman regent of the University of California.

Phoebe Apperson was born on a farm near St. Clair, Missouri. She taught school in St. James, Missouri, until 1862, when she married George Hearst, a gold and silver miner who became a millionaire. Their son was the famous newspaper publisher William Randolph Hearst.

Phoebe Hearst was an early supporter of the kindergarten movement in the United States. In 1883, she financed a building in San Francisco that housed the Golden Gate Kindergarten Association and seven kindergartens. She helped set up the Columbia Free Kindergarten Association in Washington, D.C., in 1893 and served as its first president. Kim O'Connor Kellogg

See also Birney, Alice J. M.; National Congress of Parents and Teachers.

Hearst, William Randolph (1863-1951), was a famous American publisher of newspapers and magazines. He developed a sensational journalistic style and spent millions of dollars to interest and attract readers. Critics described his style as *yellow journalism.*

Hearst had five sons, all of whom became executives in Hearst Newspapers, Inc. His son William Randolph Hearst, Jr., won a Pulitzer Prize in 1956.

Hearst was born in San Francisco. His father, George Hearst, was a mining magnate and U.S. senator. His mother was Phoebe Apperson Hearst, a philanthropist. Hearst attended Harvard University, but was expelled in 1885 because of a practical joke he played on professors. His father then gave him the *San Francisco Examiner.* Hearst made this newspaper a remarkable financial success. In 1895, he bought the *New York Journal.* He matched the *Journal* against Joseph Pulitzer's *New York World* in a circulation battle, which reached its height in 1898 during the Spanish-American War.

Hearst began buying other papers and magazines, and by 1937 owned 25 large dailies. In 1909, he founded the International News Service to serve them. His magazines included *Hearst's International-Cosmopolitan, Harper's Bazaar, House Beautiful,* and *Good Housekeeping.* Hearst pioneered in color comics, Sunday supplements, banner headlines, and editorial crusading. He had political ambitions and represented New York in the U.S. House of Representatives from 1903 to 1907. In 1904, he sought the Democratic nomination for president. He also ran unsuccessfully for governor of New York and mayor of New York City.

Hearst's oceanside estate at San Simeon, 175 miles (282 kilometers) south of San Francisco, was one of the most lavish private dwellings in the country. It included 240,000 acres (97,100 hectares) of land, four castles, and a priceless art collection. The main castle and part of the land became a California state park in 1958.

In February 1974, Patricia Hearst, the daughter of Hearst's son Randolph A. Hearst, was kidnapped by a revolutionary group called the Symbionese Liberation Army (SLA). In April 1974, she took part in a bank robbery with members of the SLA. She was arrested in 1975, and tried for robbery in 1976. Hearst was found guilty and sentenced to seven years in prison. She had spent about 22 months in prison when President Jimmy Carter *commuted* (lessened) her sentence, and she was freed shortly afterward. In 2001, President Bill Clinton pardoned her for armed bank robbery and using a firearm during a felony. Joseph P. McKerns

Additional resources

Nasaw, David. *The Chief.* Houghton, 2000.
Whitelaw, Nancy. *William Randolph Hearst and the American Century.* Morgan Reynolds, 2000. Younger readers.

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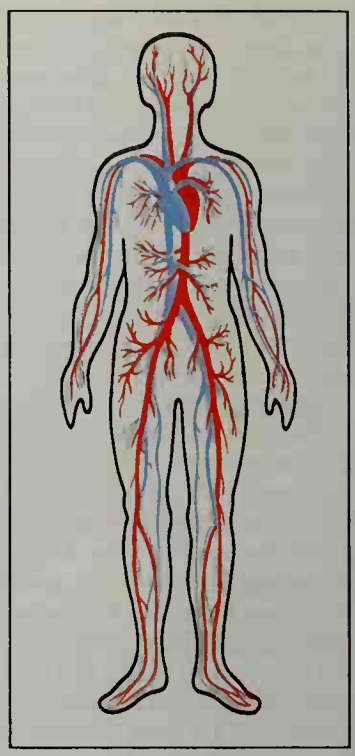


WORLD BOOK illustration by Colin Bidgood

The heart is a hollow muscular organ that pumps blood throughout the body. The heart lies in the center of the chest, between the lungs, *above.* As it rhythmically beats, the heart sends blood coursing through the arteries and veins of the circulatory system, *right.*

Heart

Heart is the hard-working muscular pump whose steady action sustains life. With each beat, the heart sends blood throughout the body to carry oxygen and food to all the body's cells. The rhythmic beating of the heart begins about seven months before birth. When the heart stops beating, we die unless some artificial method circulates and adds oxygen to our blood.

The heart is a large, hollow, muscular organ divided into left and right sides that pump at the same time. Veins collect blood from throughout the body and carry it to the right-side pump. That pump then sends blood to the lungs, where it picks up oxygen. The *oxygenated* (oxygen-rich) blood then flows to the left side of the heart, which pumps it through arteries to the rest of the body. Valves control the flow of blood through the heart. The left-side pump, which sends blood throughout the body, is larger and stronger than the right pump.

A division of the nervous system called the *autonomic nervous system* regulates the heart and blood vessels. The autonomic system controls body activities that are performed automatically, without conscious control. For example, the heart's rate automatically increases or decreases, depending on the body's needs. The heart pumps slowly while a person sleeps, providing relatively small amounts of oxygen to the resting body. But the heart rate can quickly speed up and greatly increase oxygen supplies when a person exercises, becomes frightened, or needs to fight or run.

Disease can strike any part of the heart. Although the death rate has fallen, disorders of the heart and blood vessels remain the leading cause of death in the United States and many other countries. The most common heart disease narrows the arteries that supply the heart itself with blood and oxygen. Deposits of fatty material gradually build up and block these arteries. If the heart receives too little oxygen, it may work poorly or even die. Damage to the heart muscle resulting from lack of oxygen is called a heart attack. A mild heart attack may force a person to lead a less active life, and a severe attack may cause death.

Medicine has made some of its most exciting advances in *cardiology,* the medical field that deals with diseases of the heart and blood vessels. For much of human history, doctors knew little about how the heart worked or how disease could affect the organ. In the 1900's, doctors learned to diagnose and treat many heart

Michael H. Crawford, the contributor of this article, is Robert S. Flinn Professor and Chief of the Division of Cardiology at the University of New Mexico School of Medicine.

Interesting facts about the heart

An unborn baby's heart already beats and pumps blood through the beginnings of major blood vessels by about four weeks after conception. This embryo's heart, which appears as the darker red structure, is clearly visible after about five weeks of prenatal life.

Lennart Nilsson/Albert BonniersForlag AB, *Behold Man,* Little Brown and Company

Every minute, the heart pumps about 5 $\frac{1}{4}$ quarts (5 liters) of blood—slightly more than the body's entire blood supply. In one day, the heart pumps almost 2,000 gallons (7,600 liters) of blood. In 70 years, the heart pumps about 50 million gallons (189 million liters) of blood and beats about 2 $\frac{1}{2}$ billion times.

Diseases of the heart and blood vessels are the leading cause of death in the United States. More than twice as many people die from cardiovascular diseases as from all forms of cancer. More than half of these deaths are caused by heart attacks.

© Ronald Sheridan

Ancient Egyptians believed that the heart was the center of the emotions and the intellect. An illustration from the ancient Egyptian Book of the Dead shows the god Anubis weighing a dead person's heart against a feather, the symbol of truth.

Heart muscle differs in several ways from other muscles in the body. For instance, heart muscle has certain cells that act as "leaders." These cells contract and relax rhythmically, causing surrounding cells to do the same. Even when the leader cells are removed from the heart, they continue their rhythmic beat.

conditions that once meant death. Discoveries of new drugs and great progress in surgery have added years to the lives of many heart patients. Doctors have transplanted hearts and even developed machines that can temporarily do the work of the heart.

Doctors have also learned that people can take important steps to protect the health of their hearts. Most people can greatly reduce their risk of heart disease by exercising regularly, avoiding smoking, and limiting the amount of fat and calories in their diets.

Today, much research in cardiology focuses on learning more about the causes of heart disease so that much illness can be prevented. Other research seeks to reduce death and disability from heart disease through further development of new medicines and surgical techniques. For patients who have untreatable disorders, research continues into improving heart transplantation and producing an effective artificial heart.

This article chiefly discusses the human heart. The last section briefly describes the hearts of insects, fish, birds, and other animals. For information on what blood does in the body, see the *World Book* articles on **Blood** and **Circulatory system**.

The structure of the heart

The heart lies between the lungs in approximately the middle of the chest. Each person's heart is a little larger than the size of that person's fist. A newborn baby's heart weighs about $\frac{2}{3}$ ounce (19 grams). An adult's heart weighs from 9 to 11 ounces (255 to 312 grams).

Outer lining and muscle. A membrane called the *epicardium* covers the outer surface of the heart. Another membrane, the *pericardium,* surrounds the epicardium. The pericardium completely encloses the heart and extends above the blood vessels that emerge from the top of the organ. A slippery fluid between the epicardium and the pericardium lubricates the heart and enables it to contract smoothly. Tough, fibrous bands called *ligaments* attach the pericardium to the spine and other internal structures to hold the heart firmly in place.

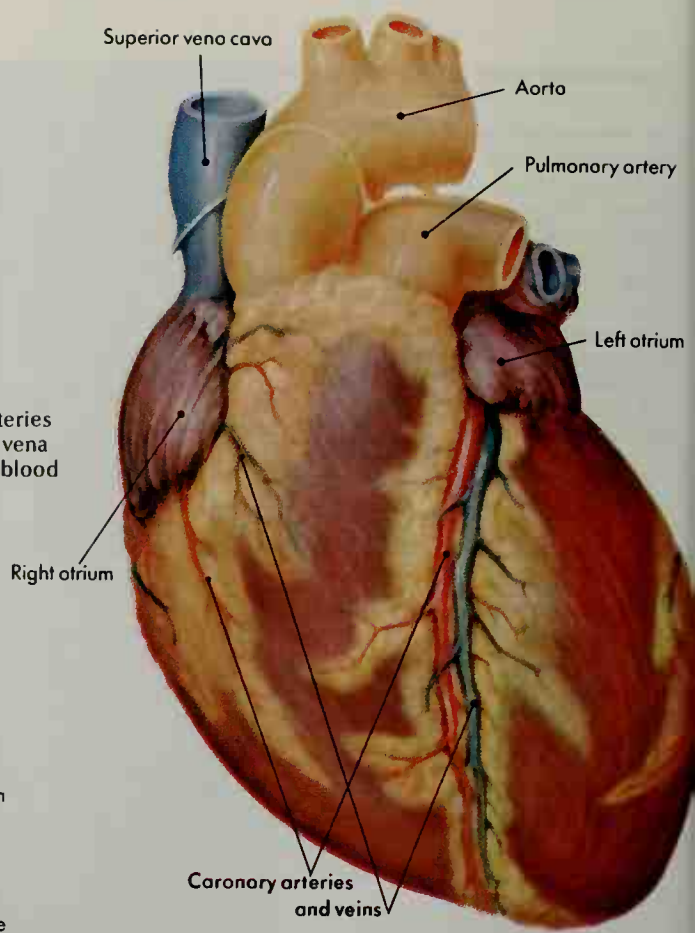
The heart consists chiefly of a special type of muscle known by the terms *heart muscle, cardiac muscle,* and *myocardium.* Heart muscle forms the strong outer walls of the organ as well as the *septum,* the wall that divides its left and right sides.

Heart muscle differs from the other two kinds of muscles in the body—that is, skeletal muscles and smooth muscles. Skeletal muscles, such as those in the arms and legs, are under our conscious control. They have long fibers with alternate dark and light bands called *striations.* Smooth muscles form the walls of the blood vessels, stomach, intestines, and most other internal organs. These muscles lack striations, and we do not consciously control them—they work automatically. Heart muscle, like skeletal muscle, has striations, but it contracts and relaxes automatically like smooth muscle. In addition, heart muscle cells work together so that a wave of contraction travels smoothly through the entire heart. These coordinated contractions keep the heart beating continuously and rhythmically throughout a person's life.

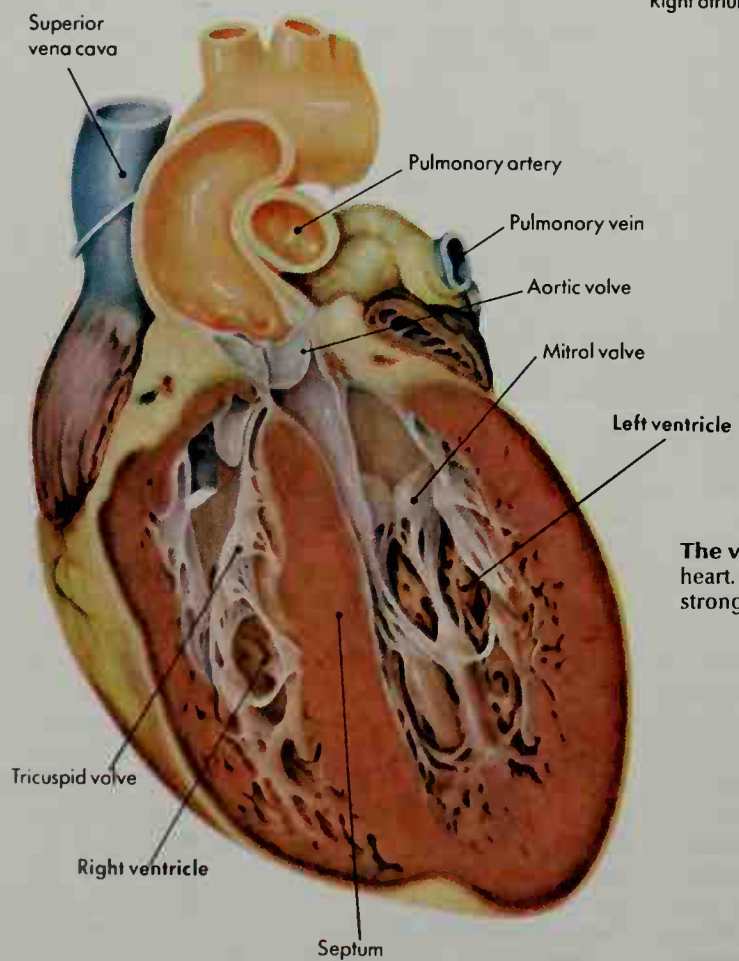
Chambers, valves, and inner lining. The muscular septum divides the heart into a left side and a right side. Movable flaps of tissue called *valves* further divide each side into two chambers that lie one above the other. A thin membrane called the *endocardium* lines the chambers. The top chambers, called the *right atrium* and *left atrium,* fill as blood returns to the heart. As each wave of contraction moves through the heart, the *atria* (plural of

Parts of the heart

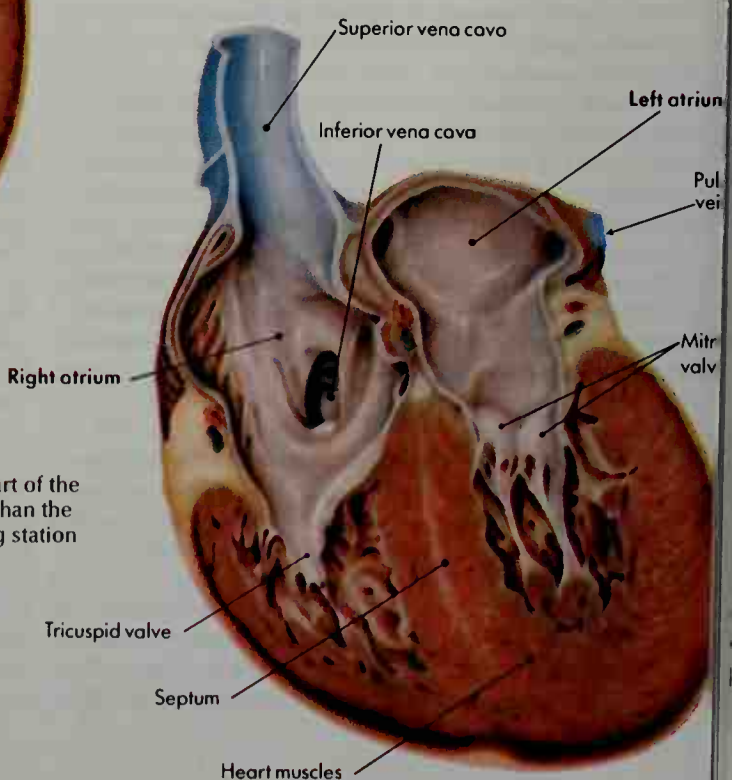
The heart lies between the lungs at the center of the chest. The lower part of the heart points toward the left side of the body. Because the beating, or pumping, takes place in the lower part, many persons incorrectly think the heart is entirely on the left side of the body. This illustration shows the heart about two-thirds normal size.



Blood vessels of all sizes serve the heart. Coronary arteries and veins nourish the heart muscle itself. The superior vena cava, aorta, and pulmonary artery are among the large blood vessels that carry blood in and out of the heart.



The ventricles, *left,* make up the largest part of the heart. They form the whole lower portion. Their thick, strong muscles pump blood throughout the body.



The atria, *right,* form the upper, smaller part of the heart. They have thin walls and are smaller than the ventricles. Each atrium serves as a collecting station for the blood that flows into the heart.

Courtesy of Abbott Laboratories International Company. Color reconstructions by Virginia Samter and Arnold R. Chaffant.

Heart terms

Angina pectoris, *an JY nuh PEHK tuhr ihs,* is chest pain that occurs because the heart does not receive enough oxygen through the blood.
Angiography, *AN jee AHG ruh fee,* is a technique used to X-ray blood vessels.
Angioplasty, *AN jee oh PLAS tee,* is a technique used to clear arteries that have become blocked with fatty deposits.
Arrhythmia, *uh RIHTH mee uh,* is an abnormal heart rhythm.
Arteriosclerosis, *ahr TIHR ee oh skluh ROH sihs,* is the hardening, thickening, and loss of elasticity in artery walls.
Atherosclerosis, *ATH uhr oh skluh ROH sihs,* is the formation of fat deposits on the inner lining of arteries.
Atrium, *AY tree uhm,* is either of the two upper heart chambers.
Cardiology, *KAHR dee AHL uh jee,* is the branch of medicine that deals with the diagnosis and treatment of disorders of the heart.
Coronary arteries are the vessels that supply oxygen-rich blood to the heart muscle itself.
Coronary artery disease (CAD) is the narrowing of the arteries that supply blood to the heart, reducing the amount of blood the heart muscle receives.
Coronary bypass is a type of surgery used to rechannel blood flow past blocked coronary arteries.
Diastole, *dy AS tuh lee,* is the period of heart activity when the ventricles relax.
Electrocardiograph is an instrument used to detect heart damage or diagnose heart disorders.
Heart attack is a sudden and complete blockage of a coronary artery, stopping blood flow to one section of heart muscle.
Heart failure occurs when the heart fails to pump enough blood.
Systole, *SIHS tuh lee,* is the period of heart activity when the ventricles contract.
Ventricle, *VEHN truh kuhl,* is either of the two lower chambers of the heart.

atrium) contract and squeeze blood into the lower chambers. These lower chambers are called the *right ventricle* and *left ventricle.* The contraction then forces blood out of the ventricles through the arteries. The ventricles, which must squeeze blood out of the heart, are thicker, larger, and stronger than the atria.

During each contraction, the flaps of the valves direct the flow of blood through the heart. These flaps open to let blood flow in the proper direction, then snap shut to prevent blood from flowing backwards. Two valves separate the atria and the ventricles. They are called the *atrioventricular (AV) valves.* The AV valve between the right atrium and right ventricle has three flaps and is called the *tricuspid valve.* The AV valve on the left side of the heart has two flaps and is called the *mitral valve.*

The heart also has valves called *semilunar valves* between each ventricle and the major blood vessel that carries blood away from it. Each semilunar valve has three flaps shaped like half moons. When the right ventricle contracts, it delivers blood to the pulmonary artery. The semilunar valve that controls blood flow to the pulmonary artery is known as the *pulmonic valve.* Because the left ventricle squeezes blood into the aorta, the semilunar valve on that side is called the *aortic valve.*

Blood vessels. Blood enters and leaves the heart through several major vessels. Blood from the body flows into the right atrium through the body's two largest veins. One, called the *superior vena cava,* brings blood from the head and arms. The other—the *inferior vena cava*—carries blood from the main part of the body and the legs. Other blood vessels transport blood between the lungs and the heart. *Pulmonary veins* return blood from the lungs to the left atrium. The *pulmonary artery* carries blood from the right ventricle to the lungs.

The *aorta* is the body's largest artery. It receives oxygenated blood from the left ventricle and, through numerous branches, distributes it throughout the body. The pulmonary artery and the aorta are sometimes called the *great vessels.*

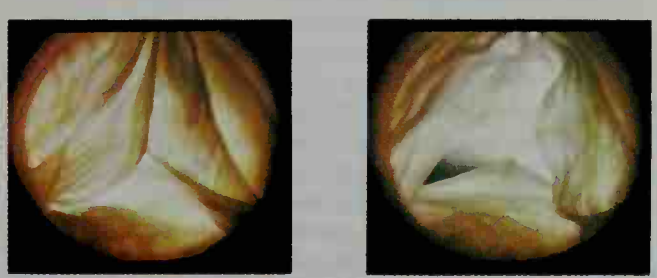
The first arteries that branch from the aorta are the two major *coronary arteries.* These two coronary arteries divide into many branches that cover the heart. Because these arteries nourish the heart muscle itself, diseases that affect them are among the most serious problems that cardiologists treat.

The work of the heart

Circulating blood. The steady pumping of the heart supports life by moving blood through the body. As it flows, blood delivers food and oxygen to all the body's cells and carries away wastes. Blood returns to the heart carrying a waste gas called *carbon dioxide* that cells produce as they use oxygen to obtain energy from food. Blood carrying carbon dioxide enters the right atrium through the superior vena cava and inferior vena cava. That atrium then contracts, squeezing the blood through the tricuspid valve into the right ventricle. After that ventricle fills, pressure forces the tricuspid valve to close and the pulmonic valve, leading to the pulmonary artery, to open. That ventricle then contracts, and the blood gushes through the pulmonary artery into the lungs. In the lungs, the blood releases carbon dioxide and picks up oxygen. See **Lung.**

Oxygenated blood from the lungs travels to the left atrium. That atrium then contracts, which squeezes the blood through the mitral valve into the left ventricle. After blood fills that ventricle, the mitral valve closes and the aortic valve opens. Blood pours into the aorta and flows through arteries to bring oxygen to the body.

Regulating the heart rate. Both sides of the heart pump blood at the same time. As the right ventricle contracts and sends blood to the lungs, the left ventricle also contracts and squeezes blood out to the body. The heart's cycle of activity has two stages, *systole* and *diastole.* Systole *(SIHS tuh lee)* occurs when the ventricles contract. Diastole *(dy AS tuh lee)* is the stage when the



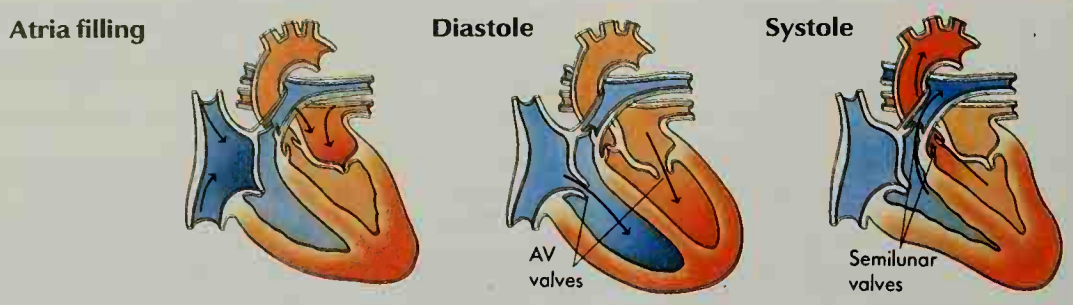
From the film *Red River of Life,* Moody Bible Institute of Science

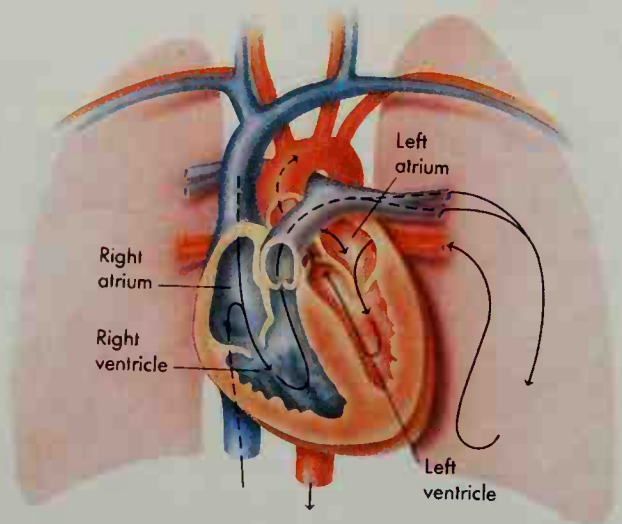
The aortic valve controls the flow of blood from the left ventricle to the aorta, the main artery of the body. In the photograph at the left, the valve's flaps are closed, preventing blood from flowing back into the ventricle. At the right, the flaps are open to let blood enter the aorta as the left ventricle contracts.

How the heart pumps blood

Deoxygenated blood, *shown in blue,* enters the right side of the heart. Oxygenated blood, *shown in red,* enters the left side. The two sides of the heart pump in unison. The right and left atria contract at the same time, as do the right and left ventricles.

WORLD BOOK illustrations by Charles Wellek





Blood goes from the right side of the heart to the lungs. It returns to the left side, from where it is pumped out to the body.

Atria filling. The heartbeat is a continuous action. The atria fill with blood at the same time the ventricles squeeze blood out to the lungs and the body. The atria collect blood and pump it to the ventricles.

Diastole. The atrioventricular (AV) valves open and the atria contract, causing blood to flow from the atria into the ventricles. This stage, during which the ventricles are relaxed and passively receive blood, is called *diastole.* The AV valves close when the ventricles are filled.

Systole. When the AV valves close, the semilunar valves open. The ventricles contract strongly, squeezing blood out of the heart through the semilunar valves. This stage, when the ventricles contract, is called *systole.* While the ventricles are still contracting, the atria begin to fill with blood again.

ventricles relax and the atria contract. One complete cycle of contraction and relaxation—called a *cardiac cycle*—makes up one heartbeat.

During each cardiac cycle, the heart valves open and close. Closing of the valves produces most of the "lub dub" sound of a heartbeat, which doctors can hear with an instrument called a *stethoscope.* As the ventricles contract, the mitral and tricuspid valves close, causing the first sound. Immediately after the valves close, pressure in the ventricles forces the aortic and pulmonic valves to open. After a contraction ends, pressure in the ventricles drops. The aortic and pulmonic valves then close, causing most of the second heart sound.

The autonomic nervous system controls the heart rate by relaying messages to the heart's electrical signaling system. The heart's electrical *impulses* (nerve signals) begin in a small bundle of specialized cells called the *sinoatrial node (S-A node).* The S-A node lies in the right atrium near where the superior vena cava enters the heart. The S-A node is also called the *pacemaker* because its rhythmic signals set the heart's rate. Impulses from the S-A node travel along certain pathways, and the atria contract when these signals reach them. The impulse then arrives at another node, called the *atrioventricular node (A-V node).* The A-V node lies in the septum between the atria and ventricles. It delays the signal briefly, allowing the ventricles enough time to fill with blood. As the impulse continues, the ventricles contract.

The nerves of the autonomic nervous system control the S-A and A-V nodes. When the body needs more blood, as during vigorous exercise, the nervous system stimulates the S-A node, which increases the rate of its impulses. These impulses keep the heart chambers contracting at a faster speed, thus pumping more blood.

Resting heart rate depends on a person's age, size, physical condition, and several other factors. A newborn baby's heart beats about 120 times per minute. For adults, doctors consider resting rates from 60 to 100 beats per minute normal. Athletic training enlarges the heart and slows the heartbeat. Many serious athletes have resting rates as low as 40 to 60 beats per minute.

Regulating blood pressure. Blood pressure is the force with which the blood pushes against the walls of the arteries as it circulates through the body. Each person's blood pressure reflects the amount of blood in the body and the strength and rate of the heart's contractions. Another important factor is the ability of the arteries to stretch in response to the force of blood.

Blood pressure is expressed as two numbers placed

one above the other. The top number, which is called *systolic blood pressure,* represents pressure during systole. This number is larger because it reflects the greater force created in the arteries during contraction of the ventricles. The bottom number represents lower pressure while the ventricles relax during diastole. This number is the *diastolic blood pressure.* See **Blood pressure.**

The heart helps regulate blood pressure by producing a hormone that helps the kidneys eliminate salt from the body. Excess salt may contribute to *hypertension* (high blood pressure). Over many years, hypertension can damage arteries and lead to heart disease, and can also injure the brain and kidneys. See **Hypertension.**

Coronary artery disease

The most common heart disorder is *coronary artery disease* (CAD). The heart needs a constant oxygen supply because it is one of the body's hardest-working muscles. It gets oxygen through the coronary arteries, which carry about 5 percent of the blood pumped from the heart directly to the heart muscle. In CAD, these arteries become narrowed, which reduces or stops their ability to carry oxygen. Insufficient oxygen may reduce the heart's ability to pump and cause pain or damage to the heart.

Causes. Nearly all CAD results from *atherosclerosis (ATH ur oh skluh ROH sihs).* Atherosclerosis is a process in which deposits of fat, calcium, and dead cells form on the inner layers of artery walls. These deposits are called *plaques.* Plaques interfere with the smooth flow of blood through arteries. Plaques that grow large enough can narrow an artery and significantly reduce blood flow. In some cases, plaques can block an entire artery and stop all blood flow. Flow may also stop if a blood clot, called a *thrombus,* forms in the narrowed artery. Plaques often crack or break, releasing substances that also can lead to blood clots. If a blood clot blocks a coronary artery, it causes a heart attack. A clot that forms in an artery in the brain causes a stroke. See **Stroke.**

Risk factors. Medical research shows that certain conditions and habits increase the likelihood that a person will develop CAD. Doctors call these conditions and habits *risk factors.* There are some risk factors that people cannot control. For example, CAD strikes more men than women and older people more than younger ones. In addition, doctors think genes are involved in some cases because CAD appears to run in some families.

People can take steps to control other risk factors involved in the disease. For example, the most important risk factor is the amount of a fatty substance called *cholesterol* that people have in their blood. Cholesterol is one of the main fats involved in forming plaques. Doctors have found that the risk of CAD rises as a person's cholesterol level increases. People can help control their cholesterol level by reducing the amount of cholesterol and other animal fats in their diet. For a discussion of healthy cholesterol levels, see **Cholesterol.**

Other controllable risk factors that may cause coronary artery disease include high blood pressure and cigarette smoking. High blood pressure stresses the heart by making it work harder, which may bring on a heart attack. In addition, the force of high blood pressure can break arterial plaques, which can also lead to blood clots and heart attacks. People can lower their blood pressure by losing weight, exercising, reducing alcohol intake, and eating less salt. Certain medicines also help reduce high blood pressure.

Cigarette smokers are more likely to develop CAD than are nonsmokers. Heavy smokers have more than twice the risk of a heart attack that nonsmokers have. But smokers who quit significantly reduce their risk of heart disease. Other risk factors that may contribute to development of coronary artery disease include diabetes, extreme fatness, lack of exercise, and stress.

Regular medical checkups are an important tool in controlling risk of CAD. During examinations, doctors can check a patient's blood pressure and cholesterol level. They can also check the blood for a substance called C-reactive protein. The body releases C-reactive protein when blood vessels leading to the heart are damaged by atherosclerosis. The level of C-reactive protein in the blood helps doctors predict the risk of heart attack. Depending on the results, they may advise people to quit smoking or to follow a special diet to control high blood pressure, cholesterol level, or weight.

Symptoms and diagnosis. Most coronary atherosclerosis develops over many years. Doctors have found the beginnings of plaques in arteries of young soldiers killed in battle. But symptoms seldom occur until age 50 or later, when arteries have narrowed more than 50 percent. In some cases, a heart attack or sudden death occurs in a person who had no previous symptoms. But many people experience an early symptom called *angina pectoris,* or simply *angina.* Angina is pain in the chest that happens during exercise or some other activity that makes the heart work harder than usual. Angina occurs because diseased coronary arteries supply the heart with too little oxygen. This lack of oxygen makes the heart muscle hurt during hard work. After the exercise or other activity stops, the pain usually disappears. However, untreated angina may worsen and cause pain even when patients are resting.

Physicians diagnose coronary artery disease by first asking patients about their general physical condition and any past illnesses. The physicians note any risk factors, such as a history of angina or heart attack in the patients or members of their families. Physical examination may reveal additional risk factors, such as high blood pressure or a high cholesterol level.

One of the most useful tools for diagnosing CAD is an instrument called an *electrocardiograph.* This instrument produces a record called an *electrocardiogram* (ECG), which displays the electrical activity of the heart muscle. This record is printed on moving paper that shows the electrical activity as a series of wavy lines.

Major waves represent contraction of the ventricles. Minor waves represent relaxation of the ventricles and contraction and relaxation of the atria. Most ECG's are recorded with the patient lying down. However, many physicians take a patient's ECG during exercise. Such a *stress ECG* shows whether a patient's heart—even if the patient has no chest pain—receives enough oxygen during vigorous exercise. See **Electrocardiograph.**

Doctors also use a method called *radionuclide imaging* to detect CAD. In this procedure, a doctor injects a radioactive element into a patient's bloodstream. The doctor can view the element on a screen as it spreads into the heart muscle. Areas that do not receive blood appear blank on the image. Doctors generally use ra-

dionuclide imaging with a stress ECG.

A type of computed tomography (CT), commonly called a *heart scan,* is sometimes used to detect calcium deposits in coronary arteries. But in many patients, the amount of calcium is not a good indicator of how severely the arteries are narrowed.

If these diagnostic techniques leave doubt about the presence of CAD, physicians may perform *cardiac catheterization* followed by *coronary angiography.* In these tests, doctors insert a long, flexible tube called a *catheter* through a large blood vessel, usually an artery in the area where the thigh and abdomen meet. They push the catheter up to the beginning of the coronary arteries, then inject a special dye. The dye clearly shows the condition of the arteries as it travels through them. An image of the arteries can be recorded on an X-ray film called an *angiogram.* Doctors perform angiography only when diagnosis is difficult, because it carries a small risk of injury or death. See **Angiography.**

Treatment. Coronary artery disease cannot be cured. But doctors can treat many patients with drugs or surgery to limit the effects of CAD on their lives. Doctors evaluate each patient with CAD to determine which treatment would provide the greatest benefit. In many cases, physicians also advise patients to exercise, reduce their intake of fat and calories, and take other steps to help slow development of CAD.

GCA/CNRI/Phototake

An angiogram of coronary arteries can show whether the vessels are narrowed by life-threatening clots or by fat and calcium deposits called *plaque.* The arteries in this image are healthy, with no abnormalities interfering with their ability to carry nourishing oxygen and food to the hard-working heart muscle.

Several drugs can relieve angina. A drug called *nitroglycerin* can stop angina pain within two minutes. When nitroglycerin tablets are dissolved under the tongue, they expand coronary arteries and enable more blood to flow past fatty deposits. Drugs called *beta-blockers* and *calcium channel blockers* may also prevent angina. Beta-blockers slow the action of the heart and reduce its contracting force. The heart's demand for oxygen then decreases, making it easier for the heart to pump. Calcium channel blockers have a similar effect on the heart and also relax the coronary arteries. These two drugs also reduce high blood pressure.

A group of drugs called *statins*—for example, lovastatin, sold under the trade name Mevacor—helps lower blood cholesterol levels. Many doctors advise CAD patients to take one aspirin tablet a day. Aspirin thins blood and can help prevent blood clots in coronary arteries.

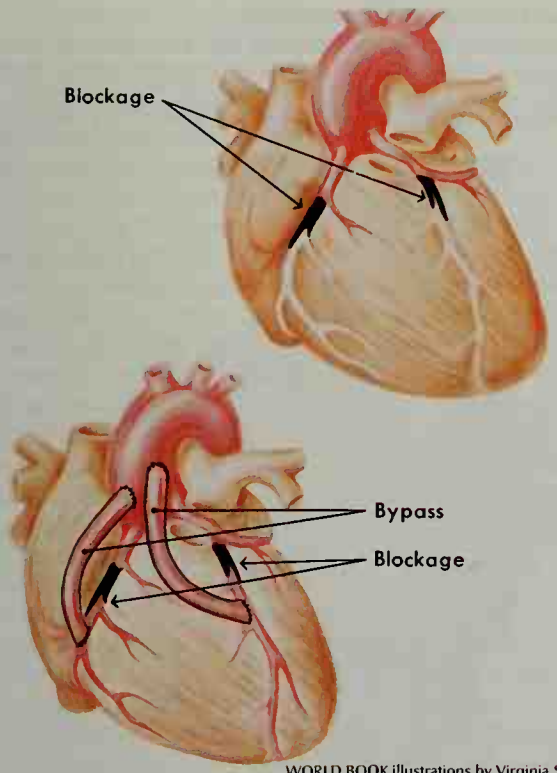
If drugs fail to control coronary artery disease, doctors consider surgical methods to correct the problem. In one procedure, called *coronary angioplasty* or simply *angioplasty,* doctors insert a catheter into the narrowed area of an artery. The catheter has a small deflated balloon attached to the end. Doctors then inflate the balloon, which compresses the plaque against the arterial wall and enlarges the artery. Angioplasty works at first in about 85 percent of patients. But in about a third of these patients, blockage returns within three months. For some patients, various methods may prevent new blockage and prolong the benefits of angioplasty. For example, tiny metal tubes called *stents* may be placed in the artery to keep it propped open. See **Angioplasty.**

If catheter treatments fail, most cardiologists suggest a more serious procedure called *coronary bypass surgery.* Bypass surgery uses a replacement blood vessel from the patient's own body to carry blood around a blockage in one or more coronary arteries. In most such procedures, doctors redirect an artery that branches from the aorta to another part of the chest. They cut the part of the vessel that leads to the chest, then reattach that end to the affected coronary artery, bypassing the blocked section. A coronary bypass can ease symptoms of angina and prolong life for patients with severe CAD. But it does not stop atherosclerosis.

During most bypasses, surgeons stop the heart and use a device called a *heart-lung machine* to take over the work of those organs. This device uses a system of membranes to exchange carbon dioxide in the blood for oxygen. An electric pump then delivers the oxygenated blood to the body. Surgeons are working to perfect techniques that avoid use of the heart-lung machine and enable them to operate directly on the beating heart.

Heart attack

Almost all heart attacks occur when a blood clot suddenly and completely blocks a coronary artery. This condition is called a *coronary thrombosis,* or simply a *coronary.* The part of the heart muscle nourished by the blocked artery becomes damaged by lack of oxygen. Unless blood flow returns within minutes, muscle damage increases. Heart cells begin to die after four to six hours without blood. The damage can affect the heart's



WORLD BOOK illustrations by Virginia Samter

Coronary bypass surgery enables blood to flow around blockages in coronary arteries. Such blockages, *top,* prevent blood from reaching the heart muscle. The surgeon uses short segments of veins from the patient's leg or arteries from the chest to construct bypasses around the blockages, *bottom.*

ability to pump and may cause the patient's death. If the clot can be dissolved within four to six hours, damage to the heart can be reduced.

Symptoms. Some people have no warning signs at the beginning of a heart attack. But many people experience angina, dizziness, indigestion, or other symptoms. Most heart attacks cause severe pain. Patients describe the pain as a dull, crushing ache in the chest, but discomfort may extend into the neck, jaw, arms, or back. The pain may last from a few minutes to several hours.

Anyone with chest pain who suspects the pain may be due to a heart attack should seek medical help immediately. Some patients may stop breathing, and their hearts may stop beating. A first-aid technique called *cardiopulmonary resuscitation* (CPR) can maintain breathing and circulation until a patient can be taken to a hospital. But CPR should be performed only by someone trained in the technique. See **Cardiopulmonary resuscitation**).

Diagnosis and treatment. Injured heart muscle causes abnormal ECG waves. Soon after a patient reaches the hospital, doctors administer an ECG to determine that symptoms result from a heart attack and not some other disorder. Doctors also use certain blood tests to detect a heart attack. But these tests are not useful until a few hours after an attack.

Doctors may administer a strong painkilling drug, such as morphine, to relieve the pain of a heart attack. They also use drugs to dissolve clots in the blocked artery or may perform emergency angioplasty or bypass surgery.

After doctors stabilize the condition of a heart attack patient, they admit the person to the hospital and monitor him or her for complications in the *intensive care unit.* Some hospitals have a specialized intensive care unit called a *coronary care unit* for heart patients. Two major complications are *heart failure* and *arrhythmia.* Heart failure occurs if the heart cannot pump enough blood because of extensive damage to the heart muscle. In most cases, heart failure can be successfully treated. In arrhythmia, the heart's electrical system produces an abnormal pattern of beats. Most arrhythmias can be readily treated, but a type called *ventricular fibrillation* can cause sudden death. Ventricular fibrillation occurs when electrical signals in the ventricles fire randomly.

More than 20 percent of heart attack patients who do not get medical care die. Some people die before they

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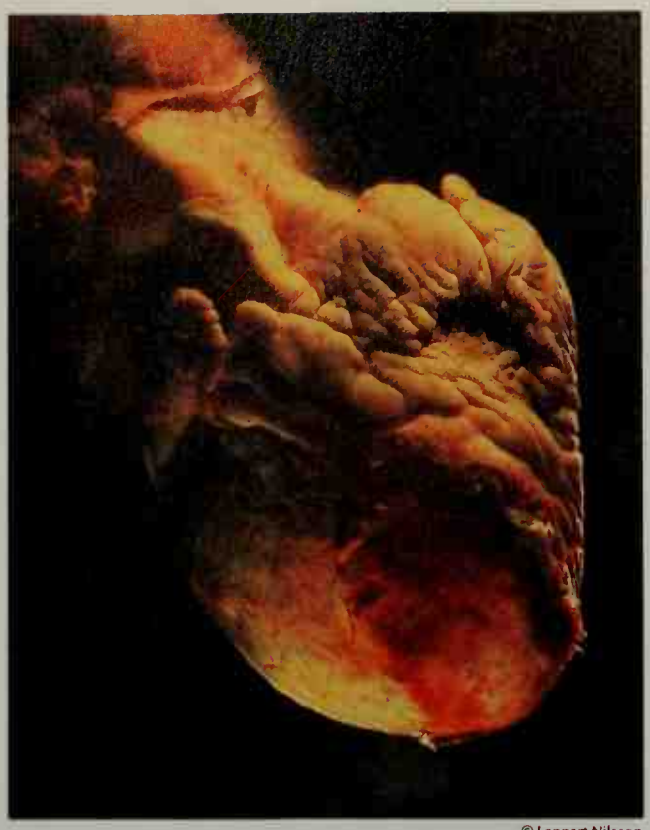
During bypass surgery, doctors open the patient's chest and expose the heart. They then stop the heart and attach the new blood vessel segments to the blocked coronary arteries. A heart-lung machine pumps and oxygenates the patient's blood during surgery.



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Heart attacks can cause severe damage to the heart muscle. The red area shown in the lower portion of this heart was deprived of oxygen during an attack and can no longer function.

can reach a doctor, but other patients ignore their symptoms and delay treatment. The death rate among hospitalized patients ranges from 5 to 10 percent. Heart attack patients with ongoing chest pain, arrhythmias, or heart failure have a greater risk of another attack than do patients without these problems.

Recovery. Many doctors perform stress tests on patients who have had a heart attack to determine their risk of having another attack or dying suddenly. Patients with abnormal stress tests may be advised to consider angioplasty or bypass surgery. People without complications are sent home for recovery and rehabilitation. Rehabilitation seeks to restore good health through a program that includes gradual increase in exercise and proper diet. The program may also include drugs to control such conditions as high blood pressure and high cholesterol. Most patients can do light work in 30 days. Complete recovery from an attack that leaves thick scars on the heart may take up to three months.

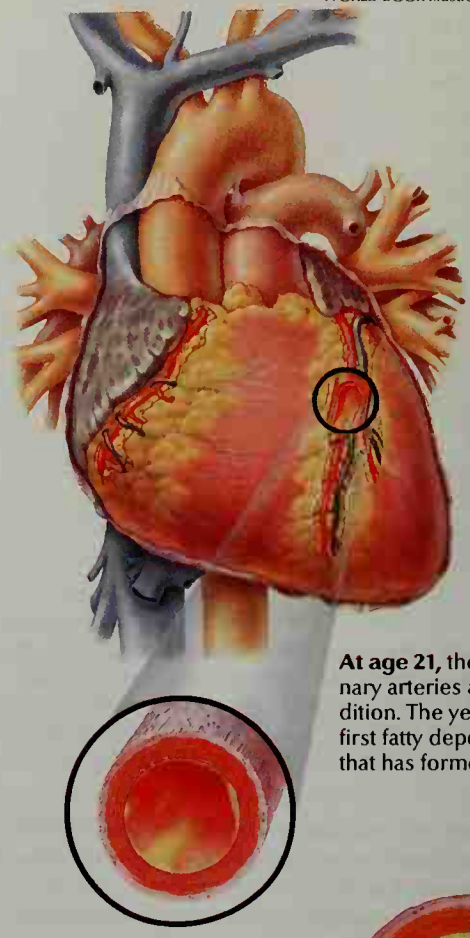
Birth defects

Heart disorders present at birth are called *congenital heart disease*. About 8 of every 1,000 babies have such abnormalities, which may be minor or so severe they are fatal. Defects occur as a baby's heart forms during its first few weeks of development in its mother's body. Doctors do not know what causes many congenital defects, but they think that some are due to genetic flaws. For example, the risk of having a congenital disorder increases for babies whose mothers have such defects. Other cases may occur as a result of certain illnesses in the mother or her use of medications. The first sign of a

Case history of a heart attack

A heart attack occurs suddenly, but the conditions that cause it take years to build up. Deposits in the coronary arteries begin early in life and eventually block the artery. These diagrams show one possible sequence of events leading to a heart attack.

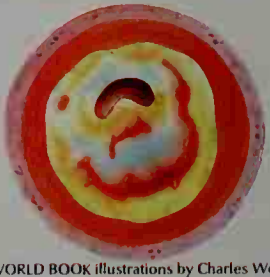
WORLD BOOK illustration by Paul Peck, M.D.



At age 21, the patient's coronary arteries are in good condition. The yellow area is the first fatty deposit, or *plaque,* that has formed.

At age 51, the coronary arteries are dangerously narrowed. Increasing plaque deposits have reduced the artery opening to about one-fourth its original area.

At age 58, the artery is almost closed. A *thrombus* (blood clot) forms in a ruptured plaque and blocks the artery, causing a heart attack.



At age 60, the patient has recovered. The artery has reopened after the heart attack, but the channel is much smaller.

WORLD BOOK illustrations by Charles Wellek

congenital defect may be an unusual sound called a *heart murmur* (see **Heart murmur**). Most such defects involve either abnormal openings in the heart or narrowed sections that block the flow of blood. Many of these disorders can be corrected surgically.

Abnormal openings in the heart. Some of the most severe congenital heart disorders are *septal defects*—that is, holes in the septum. A hole between the atria is an *atrial septal defect* (ASD), and one between the ventricles is a *ventricular septal defect* (VSD). Such holes allow oxygenated blood from the left side of the heart to enter the right side. When oxygenated blood recirculates to the lungs, it can cause congestion. Surgeons can correct both defects. VSD's are more serious than ASD's because of the extremely high pressure in the left ventricle. Some ASD's may not be detected until later in life, when blood pressure increases. If a large VSD is not corrected before a child is 2 years old, the lungs may be damaged, causing disability and premature death.

Another abnormal opening results if a blood vessel that enables the blood of unborn babies to bypass their lungs fails to close at birth. This vessel is called the *ductus arteriosus* or simply *ductus*. The ductus exists because an unborn baby's blood does not circulate through its lungs—the baby gets all its food and oxygen from its mother's body. The ductus carries blood directly from the pulmonary artery to the aorta. The ductus usually closes at birth as the baby's lungs begin to function.

In a condition called *patent ductus arteriosus* (PDA), the newborn baby's ductus stays open. As a result, the blood flow reverses and runs from the higher-pressured aorta to the pulmonary artery. As with VSD, oxygenated blood returns to the lungs, causing congestion. Death may result unless the ductus is closed. Doctors administer drugs to close it. If drugs fail, PDA can be corrected with devices attached to catheters or with surgery.

Blockage of blood flow is a common congenital heart defect. One cause of blockage is a condition called *bicuspid aortic valve*. In this disorder, people are born with an aortic valve that has two flaps instead of three. Two flaps partly block the flow of blood, resulting in a heart murmur. The defect usually presents no serious problem until adulthood, when surgery is required.

Another defect is called *coarctation of the aorta*, a narrowing of the aorta where it descends to the lower body. This narrowing may cause sudden heart failure in infants. In older children, the defect causes high blood pressure in the arms and head but low blood pressure in the legs. Surgeons usually correct the defect in late childhood, when the aorta is near full size.

A especially complicated congenital heart defect is *tetralogy of Fallot*, named after Étienne-Louis Fallot, the French doctor who first described the condition. The defect is actually a combination of four disorders—that is, a *tetralogy*. The two most serious of these disorders are a VSD and a narrowing of the pulmonic valve. The narrowed valve reduces blood flow to the lungs, increasing pressure in the right ventricle. Blood from the right ventricle passes through the VSD to the left ventricle and returns to the body. Because that blood has not flowed through the lungs and acquired the red color of oxygenated blood, it makes the skin appear bluish. As a result, babies who have this defect are called *blue babies*. Some blue babies can be treated with drugs, but most need surgery to correct the condition. See **Blue baby**.

© Thomas S. England, Photo Researchers

Rehabilitation for heart attack victims begins in the hospital. Many patients have *stress ECG*s, shown here, before they go home. This test can show the damage the heart has sustained.

Other heart disorders

Valve disease. Most valve disorders result from congenital heart defects. Valve disease can also develop if the flaps of the heart valves become scarred or deformed. There are two main types of valve disorder. A narrowing of the valve opening called *stenosis* occurs if the flaps harden. Stenosis may reduce the flow of blood through the valve. *Regurgitation*, also called *insufficiency*, arises if the flaps close improperly and permit blood to leak back into the chamber from which it came. Valve disorders may not appear until adulthood, after years of wear on the deformed valve begin to affect its function.

One common valve disorder is *mitral valve prolapse*. In this condition, the flaps of the mitral valve are slightly larger than normal and fail to close properly. Many people with mitral valve prolapse have no serious symptoms, but significant regurgitation occurs in some cases.

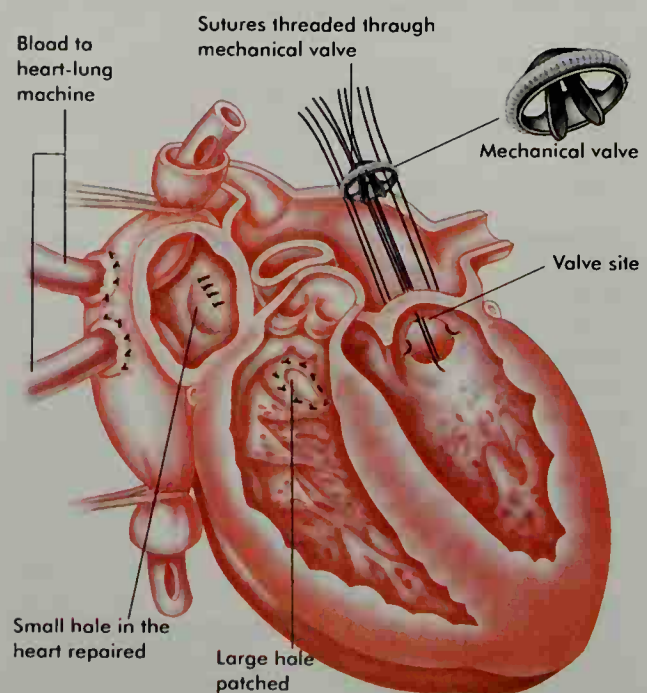
An illness called *rheumatic fever* once caused many cases of valve damage, especially to the mitral valve. Rheumatic fever is a serious reaction that can follow infection with certain streptococcus bacteria, including some that cause strep throat. Rheumatic fever has become uncommon in developed countries because most strep infections are now promptly diagnosed and treated with antibiotics. See **Rheumatic fever**.

Symptoms of valve disease include shortness of breath during exercise, tiredness, continual cough, and occasional chest pains. Doctors can make a preliminary diagnosis of valve disorders by detecting heart murmurs, sounds which result from disturbed blood flow. Regurgitation or the slowed passage of blood through a narrowed valve cause the disturbed flow.

Doctors use several methods to confirm the diagnosis and to determine the seriousness of valve disease. A technique called *echocardiography* sends ultrasound waves through the chest. The sound waves bounce off the heart, and the returning echoes are transformed into a video image of the heart's valves and other structures. Doctors also use this technique to detect disturbed blood flow, coronary artery disease, and other conditions. If echocardiography still leaves doubt about the existence of valve disease, doctors perform cardiac catheterization along with angiography.

Doctors closely monitor patients with diseased valves for any changes in symptoms. If the disorder worsens, regurgitation and stenosis may cause *congestive heart failure,* a condition in which the heart cannot pump enough blood. Doctors treat congestive heart failure several ways. They may ask patients to rest frequently, lose weight, or follow other advice to reduce the heart's workload. In many cases, doctors prescribe drugs called *angiotensin converting enzyme inhibitors* or certain other drugs to improve the heart's pumping ability.

If nonsurgical methods of treatment fail, doctors operate to repair or replace the valve. A diseased aortic valve is especially likely to need replacement. Surgeons use several types of artificial valves. One type, the *bileaflet valve,* consists of two semicircular carbon disks that open by means of a pivot mechanism. Another replacement valve comes from a pig's heart. It works much like a human heart valve. In some cases, the semilunar valves and portions of the great vessels can be replaced with transplants from donors. See **Transplant.**



St. Jude Medical® mechanical heart valve, courtesy of St. Jude Medical, Inc. All rights reserved. WORLD BOOK illustration by Barbara Cousins

Fixing heart defects. The illustration above shows three procedures for repairing heart defects. A surgeon mends a small hole in the heart by sewing the edges together, *left.* A larger hole is patched with synthetic fabric, *center.* A faulty valve is removed and replaced with a mechanical valve, *right.* The surgeon threads sutures around the valve site and through the mechanical valve, slips the valve into place, and sews it to the heart.

Abnormal heart rhythms, called arrhythmias, can range from harmless to deadly. An ECG can detect most abnormal rhythms. An arrhythmia slower than 60 beats per minute is called *bradycardia.* One faster than 100 beats per minute is called *tachycardia.*

Bradycardia may result from disease or drugs that slow the heart's natural pacemaker, which sets the heart rate by means of rhythmic electrical signals. Blockage of the electrical signal along the heart's conducting pathways produces a bradycardia called *heartblock.* If heartblock cannot be treated in any other way, doctors insert an electronic *artificial pacemaker* near the heart. This battery-operated device delivers a steady electrical signal to the heart. A pacemaker can vary its rate, depending on the person's activity level.

A tachycardia occurs if disease causes the atria or ventricles to send electrical signals too rapidly. Atrial tachycardias are relatively easy to treat. But ventricular tachycardias may lead to a condition called *fibrillation* in which disorganized contractions cause sudden death. Several drugs can stop tachycardias. If drugs fail to work on the ventricles, doctors can insert an electrical device similar to a pacemaker to overcome fibrillation. The device, called a *defibrillator,* senses when a ventricular tachycardia occurs and delivers a small shock to stop it.

Inflammatory heart disease results from conditions that cause pain and swelling in heart tissues in response to certain activities of the immune system. *Pericarditis* is inflammation of the pericardium, the membrane that surrounds the heart. It can result from infectious diseases, arthritis, kidney failure, or other disorders. Pericarditis may cause fluid to collect under the pericardium. If too much fluid accumulates, the pericardium compresses the heart so that it cannot pump enough blood to the body. The condition may cause death unless doctors drain the fluid with a needle pushed through the chest and into the pericardium. Repeated inflammation can scar the pericardium and squeeze the heart. Surgeons remove such scar tissue.

The endocardium, the membrane that lines the heart's chambers and makes up its valves, becomes inflamed in a disease called *bacterial endocarditis.* This condition arises when bacteria that normally grow harmlessly in other parts of the body enter the bloodstream and infect the heart. For example, bacteria from the mouth may enter the blood during dental surgery. In most people, normal body defenses destroy such bacteria. But in patients with valvular disease, bacteria may collect on the abnormal valve and grow. Bacterial endocarditis is fatal unless it is treated with antibiotics. To prevent endocarditis, doctors give antibiotics before and after surgery to patients who have a high risk of infection.

Inflammation of the myocardium, the muscle tissue that forms the heart's walls, is called *myocarditis.* If the inflammation damages the muscle cells beyond repair, a patient with myocarditis may require a heart transplant.

Cardiomyopathy refers to any of various diseases that affect the heart muscle itself. There are two general

forms of this disorder. In *hypertrophic cardiomyopathy,* heart muscle tissue grows excessively thick. In *congestive cardiomyopathy,* the heart muscle becomes weakened and causes heart failure.

Most cases of hypertrophic cardiomyopathy involve thickening of the septum between the heart's two lower chambers. The thickened septum blocks blood flowing from the left ventricle, causing lung congestion. The condition can be treated with drugs that relax the heart and reduce the tendency of the extra tissue to block the flow of blood. But if the disease becomes severe, surgeons must cut out the abnormal muscle.

Congestive cardiomyopathy occurs if heart muscle weakness causes the left ventricle to enlarge, resulting in inadequate pumping. In most cases, doctors do not know the cause of congestive cardiomyopathy. They have no specific treatment for the condition but may prescribe certain drugs and restrict a patient's activities to slow the progress of the disease. Some patients may need a heart transplant.

Heart failure is a disorder in which the heart pumps inefficiently. It does not mean that the heart stops beating. The organ's contractions may become weakened, or its chambers may enlarge or become less able to fill with blood. Any disease that hampers the heart's ability to deliver blood to the body may cause the condition. Most cases result from coronary artery disease, cardiomyopathy, or valve disease. The inadequate blood flow produces exhaustion. In addition, the poor flow makes the blood back up in the lungs. This congestion causes shortness of breath.

The body reacts automatically to try to overcome heart failure, but many of its efforts only worsen the condition. For example, the body tries to maintain blood flow to the brain and other vital organs by narrowing arteries to the arms, legs, and other less essential parts. But contraction of these vessels makes it even harder for the heart to pump.

Drugs are one of the main treatments for heart failure. The oldest such medicines are digitalis drugs, which doctors have prescribed for certain heart conditions for more than 200 years. Digitalis strengthens the heart's contractions, thus increasing blood flow. Much newer drugs called *vasodilators* block the body's natural but undesirable response that tightens certain arteries when heart failure occurs. Some vasodilators relax the smooth muscle in the blood vessel walls. Others block the chemical reactions that make these smooth muscles contract. Drugs that block these chemical reactions include angiotensin converting enzyme inhibitors, which are the main treatment for failure of the left ventricle.

If drugs cannot control heart failure, doctors may operate to correct any problems that led to the disorder. But surgery presents a high risk for dangerously ill patients who do not respond to drugs. Such patients may be connected to temporary *cardiac assist devices,* which are small pumps attached to the veins and arteries. These devices help the heart do its work and enable surgeons to perform necessary repairs.

If there is no problem that can be corrected surgically, doctors may perform a heart transplant. In this procedure, surgeons replace the patient's failing heart with a donated heart from the body of someone who has died. But the patient's body may reject the new heart because the body's immune system attacks most foreign tissues. Doctors try to prevent rejection with powerful drugs, but these drugs may have serious side effects.

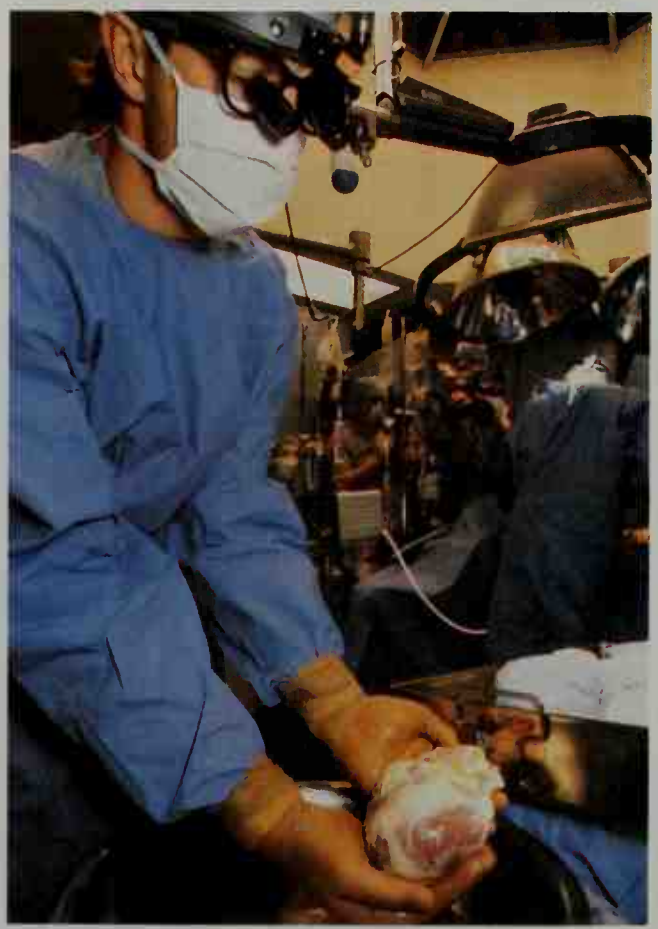
The survival rate for heart transplant patients in the first year after surgery is about 80 percent. Survival requires extensive care and close medical supervision. Many patients who need a transplant die waiting for a suitable heart because there is a shortage of donors. See **Transplant.**

During the 1980's, surgeons experimented with implanting artificial mechanical hearts in people. However, the devices proved unsuccessful because they tended to form blood clots. See **Artificial heart.**

History of heart research

Early beliefs about the heart. Many people in ancient times believed that the heart had special importance. For example, the Chinese thought that each emotion originated in a certain organ and that happiness dwelt in the heart. Chinese physicians diagnosed many illnesses and prescribed treatment by taking the pulse at the wrist. The ancient Egyptians considered the heart to be the source of intelligence and emotion.

The ancient Greeks learned from battlefield injuries and animal sacrifices that the heart was a beating organ. In the A.D. 100's, the Greek physician Galen developed the first medical theories based on scientific experiments. Galen observed the heartbeat and realized that



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Heart transplants provide a last chance for patients with severe cardiac damage. A surgeon cradles a donor heart in his hands in the operating room scene shown here.

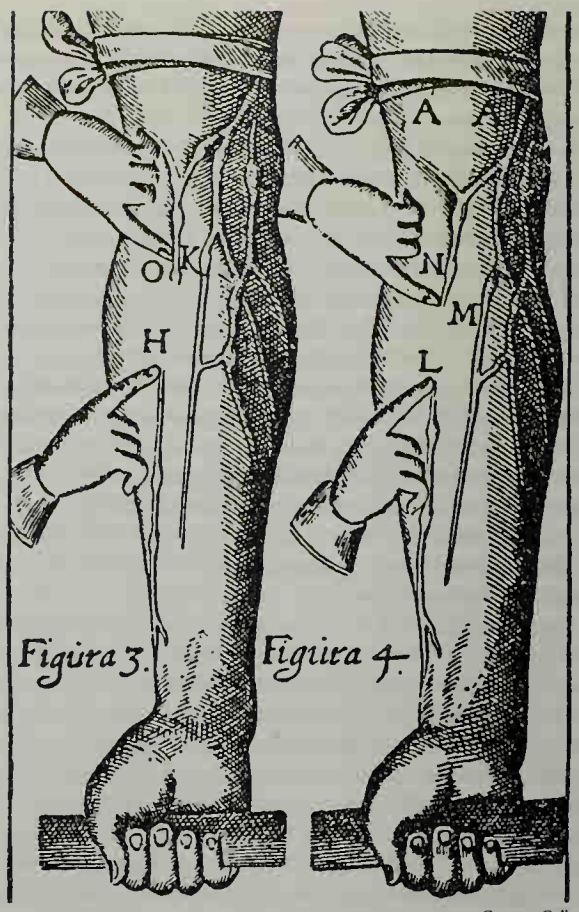
the heart put blood in motion. But he thought that the heart's right ventricle forced blood into the left ventricle through holes in the septum. Galen also believed that the liver converted food into blood, which then flowed through the body and was used up. See **Galen.**

Discovery of circulation. Doctors accepted Galen's theories—in spite of their many errors—until the 1500's. In the mid-1500's, a Flemish-born physician named Andreas Vesalius described veins and arteries. He also showed that no holes in the septum connect the heart's chambers. Also in the 1500's, Michael Servetus, a Spanish physician and theologian, reasoned that blood flows between the heart and lungs.

The theory of blood circulation was first published in 1628, by William Harvey, an English physician. His work became the basis of modern research on the heart and blood vessels. Harvey showed that the heart works like a pump. He described how blood flows from the heart to the lungs, back to the heart, out to the body, and back to the heart. Harvey believed that small blood vessels called *capillaries* connect arteries and veins. The idea of capillaries had been proposed in the 1500's by an Italian anatomist named Andrea Cesalpino. Marcello Malpighi, an Italian physician, proved their existence in 1661.

In the early 1700's, Stephen Hales, an English clergyman and scientist, became the first person to measure blood pressure. He placed a glass tube in a horse's artery after breaking through the animal's skin. Hales published the result of this experiment in 1733.

Invention of new medical instruments. During the 1800's, many inventions expanded doctors' knowledge of the heart and helped in their diagnosis and treatment of heart problems. In 1816, a French physician named



Granger Collection

William Harvey showed that the heart worked like a pump. His illustrations, such as the woodcut shown here, detailed how blood circulated to all parts of the body.

Detail of pen and ink drawings, about 1510, Windsor Castle, England, Royal Library © Her Majesty Queen Elizabeth II

Leonardo da Vinci made detailed drawings of the heart's anatomy during the early 1500's. His accurate sketches helped call into question some accepted beliefs about the heart's structure.

René Laënnec invented the stethoscope, which improved doctors' ability to listen to sounds of the heart and other organs. In 1880, Samuel Siegfried von Basch, a Viennese physician, developed the *sphygmomanometer (SFIHG moh muh NAHM uh tuhr),* an instrument that could measure blood pressure without breaking the skin. Russian physician Nikolai Korotkoff used a stethoscope in 1905 to take the pulse while measuring blood pressure, thus recording systolic and diastolic blood pressure. Doctors still use this technique.

In 1903, Willem Einthoven, a Dutch physiologist, invented the *string galvanometer.* This device, which measures electrical currents generated by the activity of the heart, became the basis of the electrocardiograph. By the 1920's, the electrocardiograph had become the chief diagnostic tool in cardiology.

Development of heart surgery. In 1912, an American cardiologist named James B. Herrick made the first diagnosis of a heart attack. In 1938, Robert E. Gross, an American surgeon, performed the first successful repair of a congenital heart defect in a child with patent ductus arteriosus. Helen Brooke Taussig and Alfred Blalock, two American physicians, developed an operation in 1944 to help correct abnormal circulation in blue babies.

In 1952, American surgeon Charles Hufnagel operated on a beating heart and implanted the first artificial heart valve. Another American surgeon, John H. Gibbon, and his associates developed the heart-lung machine. This important advance enabled doctors to stop the

heart while the device pumped and oxygenated the blood. Doctors could then repair defects that could not be corrected with the heart beating. Gibbon and his team first used the machine successfully in 1953.

F. Mason Sones, Jr., an American surgeon, performed the first angiography in 1958 and gained the first view of blockages caused by CAD. The coronary bypass operation was perfected in the late 1960's by René Favaloro, an Argentine physician working in the United States. In 1967, American surgeons Michael DeBakey and Adrian Kantrowitz successfully implanted the first cardiac assist device. This device temporarily helped a diseased or overworked left ventricle.

The first heart transplants and artificial hearts. A team of South African surgeons headed by Christiaan Barnard performed the first human heart transplant in 1967. The patient lived 18 days, then died of a lung infection. Norman Shumway pioneered heart transplants in the United States. He and his surgical team performed the first U.S. heart transplant on an adult patient in 1968. Shumway refined transplant techniques and performed more transplants than any other surgeon up to that time.

In the late 1960's and early 1970's, doctors performed many heart transplants. But most patients died within a year, mainly because the body rejected the new organ. As a result, surgeons almost stopped performing these operations. Then in the 1980's, doctors began using a drug called *cyclosporine* to fight rejection. Cyclosporine greatly increased the survival rate among transplant patients. The shortage of donor hearts has become the chief obstacle to successful heart transplants today.

Lack of donor hearts has raised interest in mechanical artificial hearts. In 1982, an American surgical team led by William DeVries implanted the first permanent artificial heart in a human. Robert Jarvik, an American physician, designed the device. The patient, Barney Clark, experienced many complications and died 112 days later. A number of other patients received the Jarvik heart, but none survived for as long as two years. In 1990, the U.S. Food and Drug Administration withdrew approval of the Jarvik device. In 2001, doctors implanted a new type of artificial heart in a seriously ill patient. Unlike other models, it was completely self-contained and thus did not require tubes or wires to be run through the patient's skin.

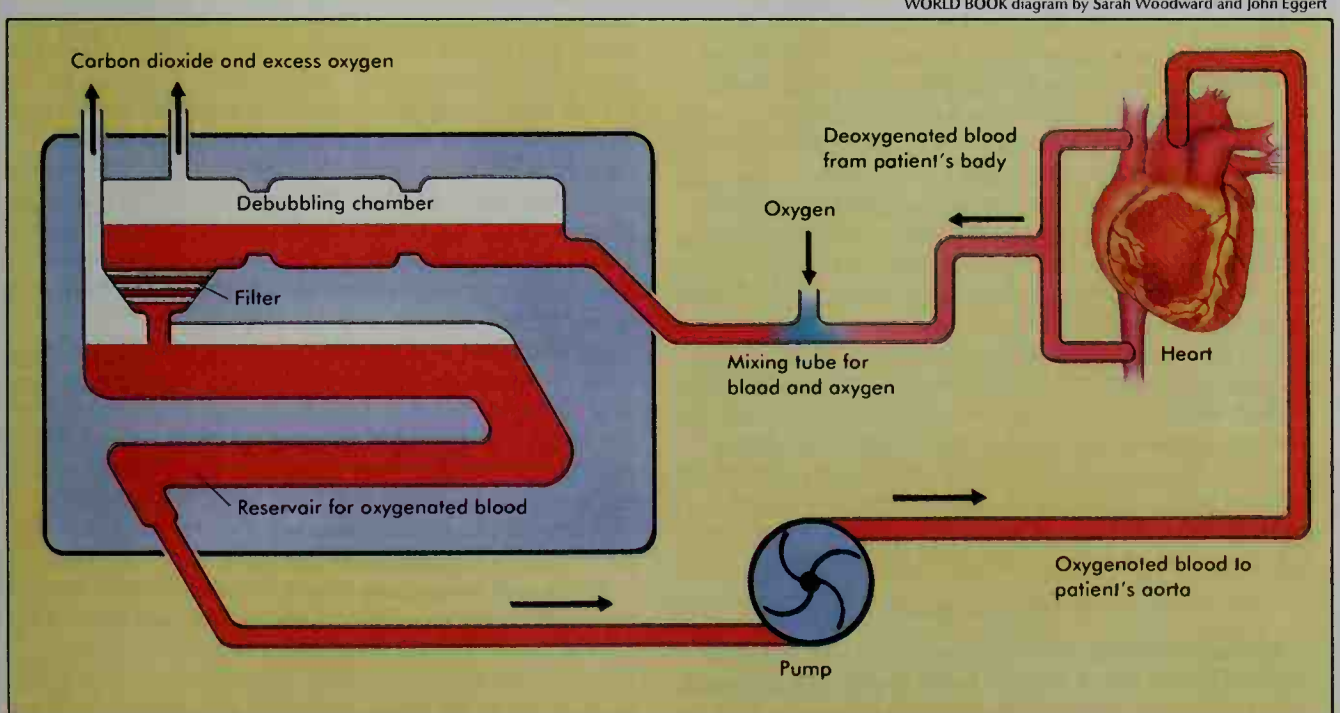
In the 1990's, efforts to help patients awaiting transplants focused on a partial artificial heart called a *left-ventricular assist device* (LVAD). An LVAD takes over the work of the the heart's main pumping chamber—the left ventricle—while the rest of the heart continues to function. LVAD's have helped some patients survive until donor hearts are available. Doctors hope that LVAD's may one day offer a permanent transplant alternative.

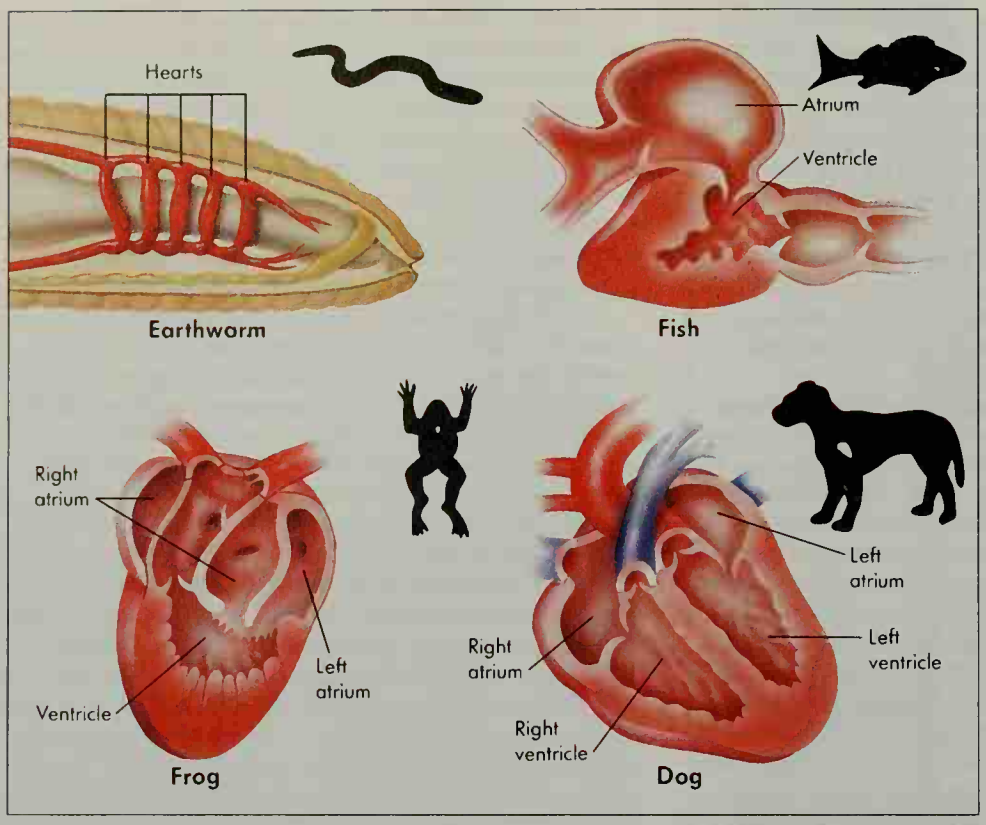
Progress in treatment and prevention occurred about the same time as the dramatic advances in heart surgery. In the late 1960's, researchers developed drugs called *beta-blockers*. These drugs help reduce high blood pressure, prevent angina, and control certain arrhythmias. Calcium channel blockers, which have similar benefits, appeared in the 1970's. In 1977, a Swiss doctor named Andreas R. Gruentzig performed the first angioplasty, a nonsurgical procedure to unblock an artery. Researchers also developed stents and other techniques to use with angioplasty to prolong its effectiveness.

The first implantable defibrillator became available in 1985. This device senses a serious, rapid arrhythmia of the ventricles and sends a small electrical shock to restore a normal heartbeat. Another method, called *radio-frequency catheter ablation,* has also been developed to

The development of the heart-lung machine in the 1950's made open-heart surgery possible. This machine enables doctors to stop the heart and repair defects. The device removes carbon dioxide from the blood and adds oxygen, as the lungs do. It then pumps the oxygenated blood back to the body through a major branch of the aorta. From there the blood circulates to the body tissues, without flowing through the heart.

WORLD BOOK diagram by Sarah Woodward and John Eggert





WORLD BOOK illustrations by Charles Wellek

Animal hearts vary in size and complexity. Earthworms, like most animals without a backbone, have contracting blood vessels that function as "hearts." Fish have a two-chambered heart, while frogs and other amphibians have a three-chambered type. Dogs, like all mammals, have a four-chambered heart, as do birds.

treat some rapid arrhythmias. In this procedure, doctors insert a catheter with an electrode tip into the heart. A small current delivered through the electrode destroys the tiny area of heart muscle causing the rapid rhythm.

Much knowledge about preventing heart disease comes from extensive research. For example, the Framingham Heart Study has examined the functioning of the heart in more than 10,000 men and women. This study began in 1948 in Framingham, Massachusetts. Its results have revealed the strong connection linking high blood pressure, high cholesterol, cigarette smoking, and other risk factors with CAD. The main shortcoming of this study is that its participants are almost all white people of similar income levels. Researchers now try to design studies to include people from a variety of ethnic groups and levels of wealth. Such diversity helps ensure that a study's conclusions apply to everyone.

Many preventive efforts focus on using known methods and finding new ones to reduce or eliminate controllable risk factors. For example, many people have their blood pressure and cholesterol level checked regularly. Patients with mild high blood pressure may reduce it by limiting their intake of salt and calories. Others may lower their cholesterol by watching the amount of cholesterol, saturated fat, and calories in their diet. In addition, growing numbers of people exercise regularly, which helps lower cholesterol and blood pressure by keeping body weight down. Drugs to reduce blood pressure and cholesterol help many patients who cannot control these factors with behavior changes.

Hearts of animals

Animals without a backbone. Many animals without backbones lack a definite heart. Instead, large blood vessels contract rhythmically, pushing blood through their bodies. These blood vessels have valves, which make blood flow in only one direction. Earthworms are one example of animals with this type of circulation.

Insects and such animals as spiders, lobsters, and crabs have a one-chambered, tubular heart into which blood flows through holes. The heart then contracts, sealing the holes and pumping blood forward into the arteries. Mollusks, such as clams and snails, have a more complicated heart with one or more atria and a ventricle. The atria, which have thin walls, receive blood from the digestive system and from the mollusk's muscular burrowing organ called the *foot.* The atria then pump blood into the thicker-walled ventricle, which sends the blood to the arteries.

Fish have a two-chambered heart with an atrium and a ventricle. Blood from the body drains into an area called the *sinus venosus,* flows into the atrium, and then enters the ventricle. From the ventricle, blood passes to an area called the *conus arteriosus* and then to the aorta. Blood is then pumped from the aorta to the arteries. Blood flows through the arteries to the gills, where it releases carbon dioxide and takes up oxygen.

Amphibians and reptiles. Adult amphibians and most reptiles have a three-chambered heart with two atria and one ventricle. One atrium receives blood from the body, and the other receives it from the lungs. Both atria pump into the same ventricle. When it contracts, a ridge within the ventricle directs most of the oxygen-rich arterial blood to the body and most of the oxygen-poor venous blood to the lungs.

Birds and mammals have a four-chambered heart, the most highly developed type. The human heart is a typical mammalian organ. Such a heart powers two types of circulation. *Pulmonic circulation* sends oxygen-poor blood to the lungs, and *systemic circulation* deliv-

ers oxygenated blood to the body. Such a circulatory system is exceptionally efficient and can pump blood at high pressure.

A bird's or mammal's heart rate depends mostly on the animal's size. The smaller an animal is, the faster its heart beats. For example, a hummingbird has a heart rate of about 1,000 beats per minute. An elephant's heart beats about 25 times a minute. Michael H. Crawford

Related articles in *World Book* include:

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Barnard, Christiaan
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Drug (Drugs that affect the heart and blood vessels)
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Rheumatic fever
Shumway, Norman E.
Smoking
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Stress test
Stroke
Tachycardia
Taussig, Helen B.
Vein
Williams, Daniel H.

Outline

I. **The structure of the heart**
   A. Outer lining and muscle
   B. Chambers, valves, and inner lining
   C. Blood vessels
II. **The work of the heart**
   A. Circulating blood
   B. Regulating the heart rate
   C. Regulating blood pressure
III. **Coronary artery disease**
   A. Causes
   B. Risk factors
   C. Symptoms and diagnosis
   D. Treatment
IV. **Heart attack**
   A. Symptoms
   B. Diagnosis and treatment
   C. Recovery
V. **Birth defects**
   A. Abnormal openings in the heart
   B. Blockage of blood flow
VI. **Other heart disorders**
   A. Valve disease
   B. Abnormal heart rhythms
   C. Inflammatory heart disease
   D. Cardiomyopathy
   E. Heart failure
VII. **History of heart research**
VIII. **Hearts of animals**
   A. Animals without a backbone
   B. Fish
   C. Amphibians and reptiles
   D. Birds and mammals

Questions

How does heart disease rank as a cause of death?
What are *septal defects*?
How does an *angioplasty* work?
What is *atherosclerosis*?
What happens to blood in the lungs?
Who performed the first human heart transplant?
How does heart muscle differ from other muscles?
What complications can result from a heart attack?
Why must patients wait for a heart transplant?
How do doctors perform a *coronary bypass*?

Additional resources

Level I

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Simon, Seymour. *The Heart.* Morrow, 1996.

Level II

DeBakey, Michael E., and Gotto, A. M. *The New Living Heart.* Adams Media Corp., 1997.
Gersh, Bernard J., ed. *Mayo Clinic Heart Book.* 2nd ed. Morrow, 2000.
Mehler, Robert E. *How the Circulatory System Works.* Blackwell Science, 2001.

Heart Association, American, is a national voluntary health agency organized to fight diseases of the heart and blood vessels. It sponsors research, community services, and professional and public education on heart disease. The American Heart Association has about 2,000 state and metropolitan affiliates, divisions, and branches throughout the United States and Puerto Rico. It has about 105,000 active members, including about 40,000 physicians. More than 3 million volunteers also participate in the work of the association.

The American Heart Association gains financial support for its program from the general public through contributions made to the association or to its Heart Fund. The association has its national headquarters in Dallas. Critically reviewed by the American Heart Association, Inc.

Heart attack. See Heart (Heart attack); First aid (Heart attack).

Heart murmur is an abnormal sound in a person's heartbeat. An *organic murmur* is a symptom of heart disease. It is produced by the blood flowing through defective heart valves or across defects between chambers of the heart. A diseased heart valve may not close tightly or open completely when the heart contracts, and the forceful passage of blood around the valve causes a murmur. Causes of organic murmur include (1) rheumatic fever, (2) heart deformities present at birth, and (3) *arteriosclerosis* (hardening of the arteries). A *functional murmur,* also called an *innocent murmur,* occurs in the absence of heart disease. It may appear after a person exercises strenuously. Bruce A. Reitz

Heartburn, also known as *pyrosis,* is a painful, burning sensation in the esophagus. Heartburn results when acidic stomach contents surge upward into the esophagus or when the esophagus undergoes intense spasms. Heartburn usually begins just below the tip of the breastbone, near the heart, and rises toward the throat. In some cases, the mouth suddenly fills with a large amount of clear, watery saliva called *water brash.* The pain of heartburn may last several hours.

Heartburn accompanies many types of indigestion. It most frequently occurs after a person drinks a hot or cold liquid. People who are tense or tired may suffer from heartburn, especially after eating. Pregnant women and people who have ulcers or gallbladder disease may also experience heartburn. Antacid medications can temporarily relieve heartburn pain. Roberta L. Bondar

See also Indigestion; Ulcer.

Heartwood. See Sap.

Heartworm. See Dog (Medical care).

Fritz Henle, Photo Researchers

People use heat in many ways to do work and to make life more comfortable. In this foundry furnace, for example, heat is used to soften steel so that it can be shaped into the desired form. The steel becomes so hot it gives off light.

Heat

Heat is one of the most important forms of energy. When we think of heat, we usually think of how heat makes us feel. On a hot day, for example, it may make us feel uncomfortable. But heat is far more important in our lives than simply how it may make us feel.

We must have a carefully controlled amount of heat to live. Our bodies use the food we eat to produce the heat that keeps our temperature at about 98.6 °F (37 °C). If our body temperature rises too far above normal—or falls too far below normal—we can die. In cold weather, we wear heavy clothes to hold in our body heat. During warm weather, we wear light clothes to let the unneeded heat escape.

No one knows how high temperatures may climb, but the temperature inside the hottest stars is many millions of degrees. The lowest possible temperature, called *absolute zero,* is −459.67 °F (−273.15 °C).

Ared Cezairliyan, the contributor of this article, is a Research Physicist at the National Institute of Standards and Technology.

In our homes, we use heat in many ways. Heat warms our homes and cooks our food. It also provides hot water, dries the laundry, and makes electric light bulbs give off light.

In industry, the uses for heat are almost endless. Heat is used to separate metals from their ores and to refine crude oil. It is used to melt, shape, cut, coat, and harden metals and to join metals together. Heat is also used to make or process foods, glass, paper, textiles, and many other products.

Heat also runs our machinery. The heat from burning fuels in engines provides the power to move airplanes, automobiles, rockets, and ships. Heat causes the wheels of giant turbines to spin, driving generators that produce electricity. Electricity provides light and furnishes power to run all kinds of equipment—from electric pencil sharpeners to electric trains.

This article discusses where heat comes from and what heat is, how it travels, and what it does. The article also describes how we have put heat to work and the discoveries we have made about heat.

Anything that gives off heat is a source of heat. The heat that we use or that affects life and events on the earth comes from six main sources. They are (1) the sun, (2) the earth, (3) chemical reactions, (4) nuclear energy, (5) friction, and (6) electricity.

We control some of these sources, and others we do not. We use the sources we control, such as electricity and nuclear energy, to heat buildings and do other work. But the sources we do not control also benefit us. For example, the sun provides the heat and light that make life possible. All sources of heat, even those that we normally control, can do great damage if they get out of control. For example, fires, which are chemical reactions, destroy much property every year.

The sun is our most important source of heat. If the sun should ever cool, the earth would become cold and lifeless. Only a tiny fraction of the heat produced in the sun strikes the earth. Yet it is enough to keep us—and all other organisms on the earth—alive.

The sun's heat is absorbed by the seas, the ground, plants, and the atmosphere. Large amounts of heat can be collected by using such devices as large *solar furnaces.* These furnaces have mirrors that reflect the sun's light from a wide area onto one spot. Some solar furnaces can generate enough heat to melt steel. Smaller ones can gather enough heat to cook food. See **Solar energy; Sun.**

The earth itself contains much heat deep inside. When a volcano erupts, some of this heat escapes to the surface. The lava from a volcano is rock melted by the heat deep within the earth. Some of the earth's heat also escapes in *geysers.* These springs shoot forth boiling water that has been heated by hot rocks within the earth. People have begun to use the earth's heat to generate electricity, warm up houses, and do other work. See **Earth** (Earth's interior; Earth's crust); **Geyser; Volcano.**

Chemical reactions can produce heat in a number of ways. A chemical reaction in which a substance combines with oxygen is called *oxidation.* Rapid oxidation produces heat fast enough to cause a flame. When coal, wood, natural gas, or any other fuel burns, substances in the fuel combine with oxygen in the air to form other compounds. This chemical reaction, which is known as *combustion,* produces heat—and fire.

People use fire in many ways. Fire in a gas stove produces heat to cook food. Coal, oil, or gas fires in furnaces and boilers heat buildings. Fire heats metals red-hot so that they can be shaped into a variety of forms. Special cutting torches can produce flames hot enough to cut through metal. See **Fire.**

Another example of combustion is the burning of gasoline in the cylinders of an automobile engine. This process produces heat that causes the gases in the cylinders to expand and move parts that make the engine work. See **Combustion.**

The rusting of iron is also an example of oxidation. Unlike fire, however, rusting occurs so slowly that little heat and no flames are produced. See **Oxidation.**

The mixing of certain kinds of chemicals also produces heat. For example, if sulfuric acid and water are combined, the mixture becomes boiling hot.

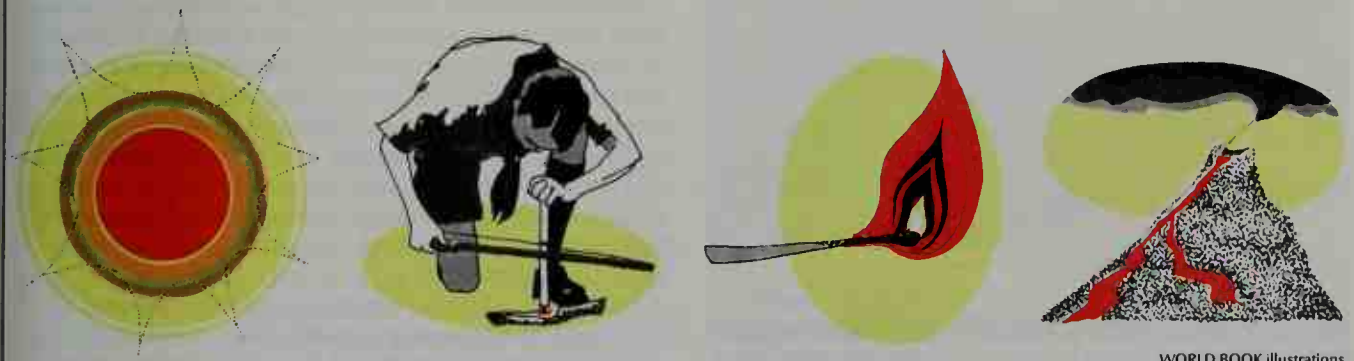
In all living things, food is changed into heat—as well as energy and living tissue—by the process of *metabolism.* Metabolism is a complicated series of chemical reactions carried out by living cells. See **Metabolism.**

Nuclear energy can produce great quantities of heat. Nuclear weapons release so much heat so quickly that they destroy everything around them. Their heat cannot be put to useful work. But in a device called a *reactor,* heat can be produced from nuclear energy slowly enough to generate electricity and to do other jobs. See **Nuclear energy.**

Friction. When one object rubs against another, heat is produced. Friction is usually an unwanted source of heat because it may damage objects. In a machine, for example, the heat created as the moving parts rub against one another may cause those parts to wear down. For this reason, oil is used between moving machinery parts. The oil reduces friction and so decreases the generation of heat. See **Friction.**

Electricity. The flow of electric current through metals, alloys, and other *conductors* (substances that carry electric current) generates heat. People make use of this heat in the operation of many appliances, including electric furnaces, ovens, ranges, dryers, heaters, toasters, and irons. See **Electricity.**

Sources of heat



WORLD BOOK illustrations

The sun produces heat from nuclear reactions deep inside it. All life on the earth depends on this heat.

Friction—the rubbing of one object against another—produces heat. Scouts learn to start a fire with friction.

Chemical reactions produce heat by causing a chemical change in substances. Fire is a chemical reaction.

The earth contains much heat deep inside. Some of this heat escapes to the surface when a volcano erupts.

Heat is a form of energy. Heat and energy cannot be seen, but the work they do can. For example, the burning of fuel in the engines of a jet airplane creates hot gases. These gases expand and provide the power that moves the plane. See Energy.

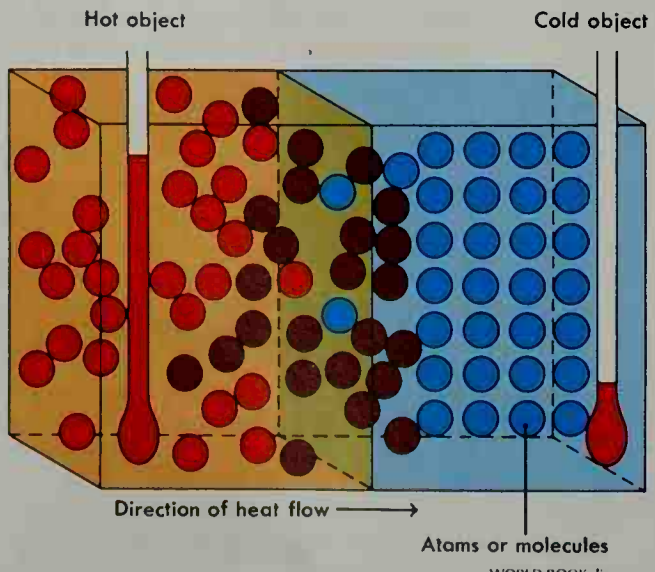
Temperature and heat. All things are made up of atoms or molecules, which are always moving. The motion gives every object *internal energy*. The *level* of an object's internal energy depends on how rapidly its atoms or molecules move. If they move slowly, the object has a low level of internal energy. If they move violently, it has a high level. Hot objects have higher internal energy levels than do cold objects. The words *hot* and *cold* refer to an object's temperature.

Temperature is an indication of an object's internal energy level. A thermometer is used to measure temperature. Thermometers have a numbered scale so that temperature can be expressed in degrees. The two most common scales are the *Fahrenheit* and the *Celsius,* or *centigrade,* scales. See **Temperature.**

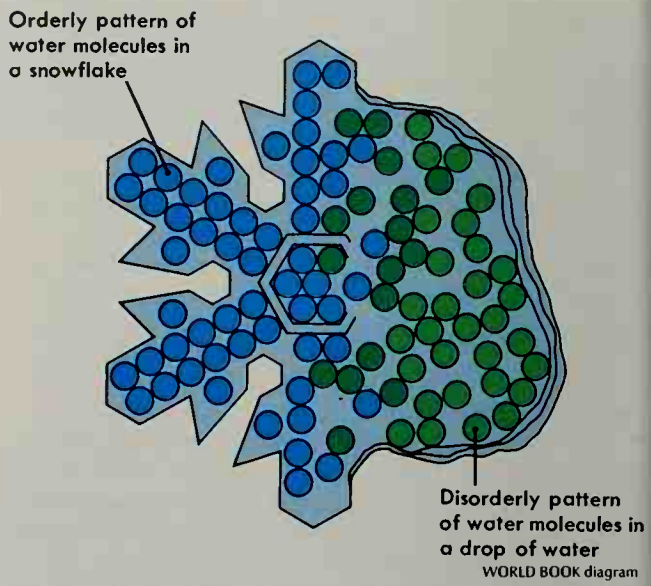
The temperature of an object determines whether that object will take on more internal energy or lose some when it comes into contact with another object. If a hot rock and a cold rock touch each other, some of the internal energy in the hot rock will pass into the cold rock as heat. If a thermometer were placed on the hot rock, it would show the rock's temperature falling steadily. A thermometer on the cold rock would show a steadily rising temperature. Eventually, the thermometers on the two rocks would show the same temperature. Then, no further flow of heat would occur.

Just as water flows only downhill, so heat flows only down a "temperature hill," passing from an object at a higher temperature to an object at a lower one. The greater the difference in temperature between two objects, the faster the heat will flow between them.

It is important to recognize that temperature and heat



Heat energy flows from a hot to a cold object when they are in contact. The rapidly moving atoms or molecules in the hot object strike the less energetic atoms or molecules in the cold object and speed them up. In this way, internal energy in the form of heat passes from a hot object to a cold object.



Heat decreases the orderly arrangement of the atoms or molecules in an object. For example, the molecules of water in a snowflake are frozen in an orderly pattern. But as heat flows into the flake, its molecules move more rapidly. They become so disorderly that the snowflake begins to melt.

are not the same thing. Temperature is simply an indication of the level of internal energy that an object has. Heat, on the other hand, is the passage of energy from one object to another.

The three units most commonly used to measure heat are British thermal units (Btu's), calories, and joules. One *Btu* is the quantity of heat needed to raise the temperature of 1 pound of water 1° F. One *calorie* is the quantity of heat needed to raise the temperature of 1 gram of water 1° C. The calorie used to measure food energy is 1,000 times as large as this calorie. The Btu is generally used in engineering, and the calorie in the sciences. The *joule* can be used for measuring all forms of energy, including heat. One joule is the amount of energy used—or work done—when a force of 1 newton moves an object 1 meter in the direction of the force. See **British thermal unit; Calorie; Joule; Newton.**

Disorder. Temperature and internal energy tell only part of the story about heat. To tell the whole story, we need to see what happens to the atoms or molecules of an object when heat flows into it.

As heat enters an object, that object's atoms or molecules move around more. The more heat that flows in, the more the object's atoms or molecules move around and the more disorderly they become. For example, the water molecules in a snowflake have an orderly pattern. But if a snowflake is taken into a warm room, it will melt and become a drop of water. Heat changes the orderly pattern of the snowflake into disorder. Scientists use the term *entropy* to describe the amount of disorder in an object. See **Entropy.**

Heat flowing into an object increases the internal energy and disorder in that object. Usually, the added heat also raises the temperature of the object. On the other hand, heat flowing out of an object decreases the internal energy and disorder in that object. Usually, the heat loss also lowers the temperature of the object.

Heat passes from one object or place to another by three methods: (1) conduction, (2) convection, and (3) radiation.

Conduction is the movement of heat through a material. When heat travels by conduction, it moves through a material without carrying any of the material with it. For example, the end of a copper rod placed in a fire quickly becomes hot. The atoms in the hot end begin to vibrate faster and strike neighboring atoms. These atoms then vibrate faster and strike adjoining atoms. In this way, the heat travels from atom to atom until it reaches the other end of the rod. But during the process, the atoms themselves do not move from one end to the other.

Convection is the transfer of heat by the movement of a heated material. For example, a hot stove in a room heats the air around it by conduction. This heated air expands and so is lighter than the colder air surrounding it. The heated air rises, and cooler air replaces it. Then the cooler air near the stove becomes warm and rises. This movement of heated air away from a hot object and the flow of cooler air toward that object is called a *convection current*. The current of air carries heat to all parts of the room.

Convection occurs in liquids as well as in gases. For example, convection currents will form in a pan of cold water on a hot stove. As the water near the bottom of the pan warms up and expands, it becomes lighter than the cold water near the top of the pan. This cold water sinks and forces the heated water to the top. The convection current continues until all the water reaches the same temperature.

Radiation. In conduction and convection, moving particles transmit heat. But in radiation, heat can travel through a vacuum, which has no particles. In any object, the moving atoms or molecules create waves of radiant energy. These waves are also called *infrared rays*. Hot objects give off more infrared rays than do cold objects. Infrared rays travel through space in much the same way as water waves travel on the surface of a pond. When the radiant energy strikes an object, it speeds up the atoms or molecules in that object. Energy from the sun travels through space to the earth. These rays warm the earth's surface. See **Infrared rays**.

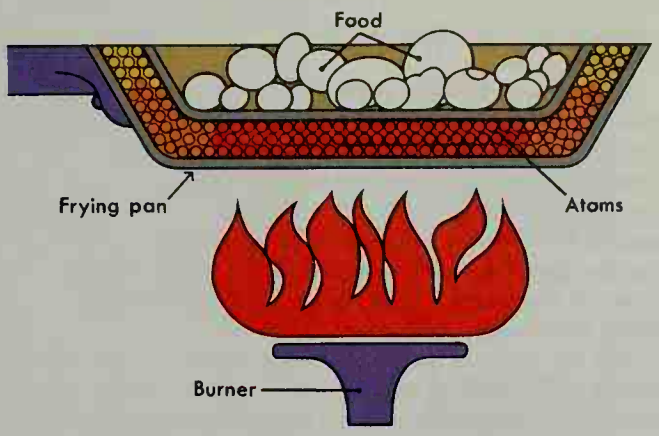
Insulation is a way to control the movement of heat by keeping it in or out of a place. For example, houses are insulated to keep the heat inside in winter and outside in summer. People use three methods of insulation because heat can travel in any one of three ways.

Certain materials, such as plastic and wood, make good insulators against the movement of heat by conduction. This is why many pots and pans have plastic or wood handles. The metal utensil itself heats rapidly by conduction, but the handle stays cool.

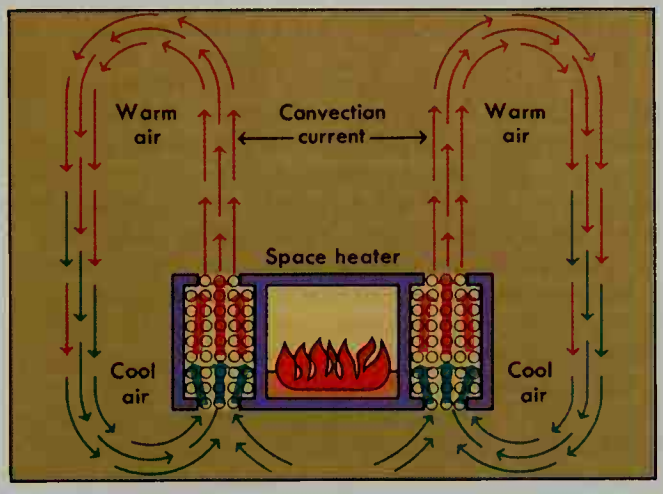
The movement of heat through the air by convection can be controlled by blocking the space between a hot and cold area with "dead air." For example, the layer of air between a storm window and the inner window acts as an insulator.

Surfaces that reflect infrared rays can insulate heat traveling by radiation. For example, shiny metal roofs reflect the sun's rays. See **Insulation**.

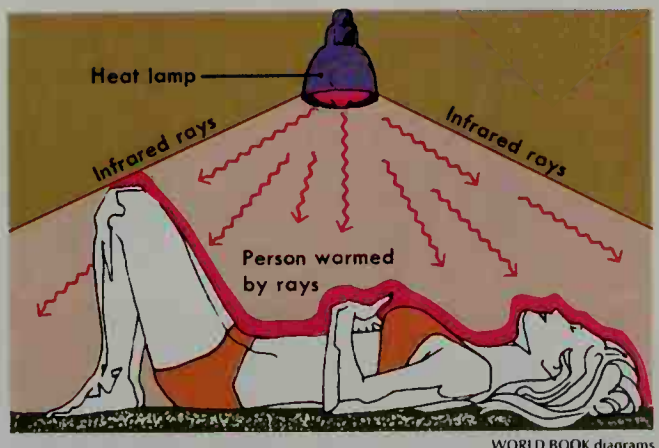
How heat travels



Conduction carries heat through an object. For example, heat from a burner makes the atoms on the underside of a frying pan vibrate faster. These atoms then strike atoms above them. In this way, heat passes through the pan to the food inside it.



Convection carries heat by circulating a heated material. A space heater, for example, warms the air around it. This heated air rises and is replaced by cooler air. The movement of air creates a *convection current* that carries hot air through a room.



WORLD BOOK diagrams

Radiation carries heat in the form of waves through space. A hot wire in a heat lamp gives off waves of radiant energy called *infrared rays*. When these rays strike someone, their energy warms that person.

What heat does

When heat passes into or out of a substance, it may change that substance in three ways. Heat may cause (1) changes in temperature, (2) changes in size, and (3) changes in state.

Changes in temperature are one of the most common results when heat flows into or out of an object. The amount of heat needed to raise the temperature of one gram of a substance one degree Celsius is called the *specific heat capacity* of the substance. Specific heat capacity is often called simply *specific heat.* Scientists use the specific heat of water, which is given a value of 1, as the standard for figuring the specific heat of all other substances.

You can find out how much the temperature of a substance will rise when heat flows into it if you know how much *mass* (amount of matter) the substance has and what the specific heat of the substance is. First, multiply the mass by the specific heat of the substance. Then, divide the result into the amount of heat added. For example, if 10 calories of heat flow into one gram of water, how much will the temperature of the water rise? One gram multiplied by a specific heat of 1 equals 1. One divided into 10 calories equals a rise of 10 degrees Celsius.

Two substances with the same mass but different specific heats require different amounts of heat to reach the same temperature. The temperature of a substance with a low specific heat will increase more than that of a substance with a high specific heat if both substances receive the same amount of heat. For example, it takes 10 calories of heat to raise one gram of water 10 degrees Celsius. But 10 calories will raise the temperature of one gram of copper 111 degrees. Copper has a low specific heat of 0.09, compared with water's specific heat of 1.

Changes in size. As we have seen, when heat flows into a substance, the motion of the atoms or molecules in the substance increases. As a result of their increased motion, the atoms or molecules take up more space and the substance expands. The opposite occurs when heat flows out of a substance. The atoms or molecules move more slowly. They therefore take up less space, and the substance contracts.

All gases and most liquids and solids expand when heated. But they do not expand equally. If a gas, a liquid, and a solid receive enough heat to raise their temperatures the same amount, the gas will expand most, the liquid much less, and the solid the least.

Thermometers, thermostats, and many other devices work on the principle of expansion and contraction. Many thermometers contain a liquid, such as alcohol or mercury, that expands and contracts evenly as the temperature changes. A rise or fall in temperature causes the volume of the liquid to expand or contract only slightly. But by making the liquid occupy a narrow glass tube, the liquid column moves enough so the temperature change can be seen.

Changes in temperature also cause the materials that are used in bridges, buildings, and other structures to expand and contract. This expansion and contraction can cause serious problems if the builders do not allow for it. For example, the steel beams used in a building will bend or break if they do not have room to expand. For this reason, structures have *expansion joints,* which allow extra space for the materials to expand and contract without damage when the temperature changes.

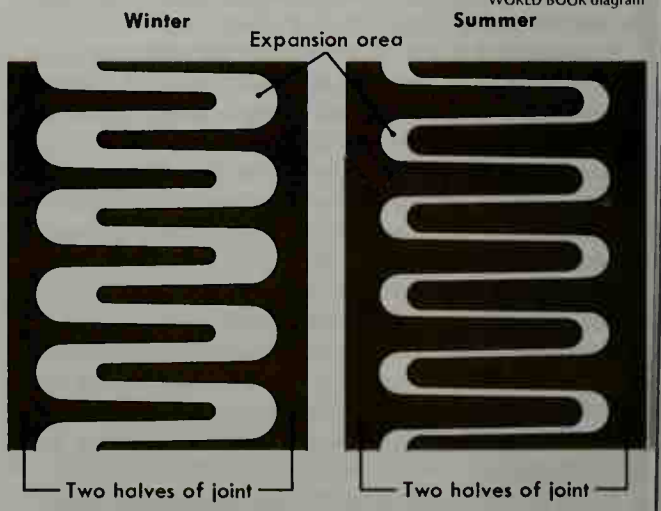
Engineers can determine how much the length of any material will increase when its temperature rises if they know the *coefficient of linear expansion* of the material. The coefficient of linear expansion indicates how much longer each meter of the material will become if its temperature increases by one degree. For aluminum, it is 0.000023. Thus, each meter of an aluminum bar becomes 0.000023 of a meter longer with each degree Celsius increase in its temperature.

The specific heats of different metals can be compared by heating samples of equal weight to the same temperature and then setting them on a block of wax, *top.* The samples with high specific heats sink deepest in the wax, *bottom.*

WORLD BOOK photo

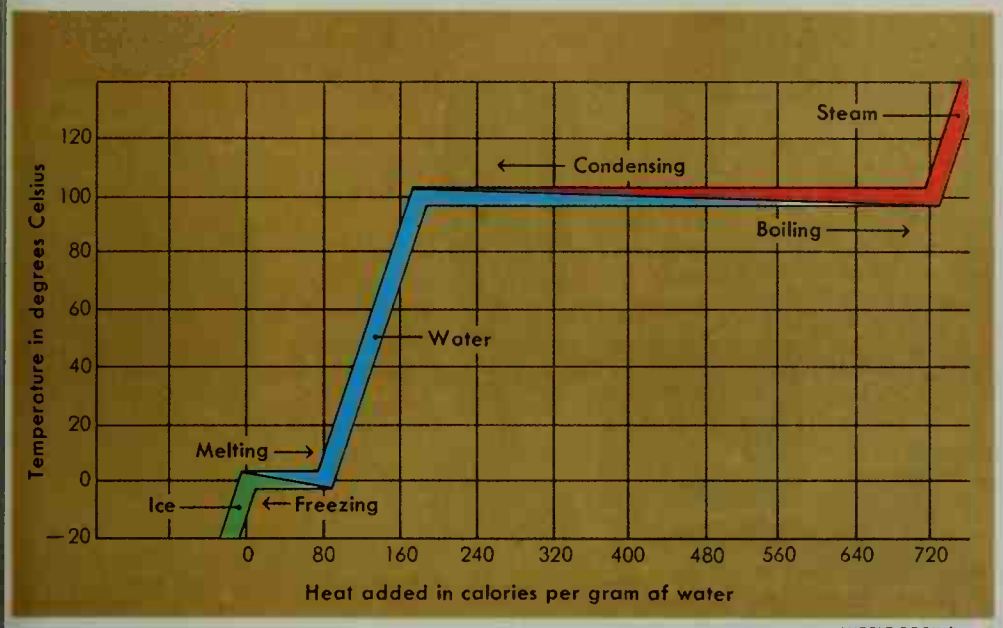
An expansion joint allows the materials in bridges, buildings, and other structures to contract and expand without damaging the structure. The joint opens in winter, when the materials contract, and closes in summer, when they expand.

WORLD BOOK diagram



In winter, the fingers of the joint pull apart as the materials contract.

In summer, the fingers of the joint move closer together as the materials expand.



WORLD BOOK diagram

Heat causes solids to melt and liquids to boil. The heat added to a solid, such as ice, raises its temperature to its melting point. Then the temperature stops rising until enough additional heat flows in and melts all the ice. More heat raises the temperature of the water to the boiling point. The temperature again stops rising until enough heat is added to turn all the water to steam.

Changes in state. Ordinarily, the temperature of an object rises when heat flows into it. But under certain circumstances, the addition of heat causes no increase in an object's temperature. Instead, the disorder of the atoms or molecules in the object increases and causes the material to change state.

If heat is added to a block of ice that is colder than 0° C, the temperature of the ice will increase until it reaches 0° C, its melting point. Then the temperature will stop increasing for a time, even though more heat flows into the ice. The additional heat will increase the disorder of the molecules in the ice and cause the ice to melt. But until all the ice has melted, the water will remain at 0° C. The heat needed to change ice to water is called the *heat of fusion*. Each gram of ice at 0° C requires 80 calories of heat to melt it to water at 0° C.

As more heat flows into the water at 0° C, the temperature of the water will again rise until it reaches 100° C, its boiling point. Under normal atmospheric pressure, additional heat will not raise the temperature any further. Instead, some of the water will change into steam. Not until all the water has become steam will additional heat cause the temperature to increase again. The heat required to change water at 100° C into steam at the same temperature is called the *heat of vaporization*. Each gram of water at 100° C requires 540 calories of heat to become steam. More heat added to the steam will raise its temperature above 100° C.

A liquid can also become a gas at a temperature below its boiling point through evaporation. Evaporation occurs at the surface of a liquid. The molecules at the surface break free from those below and enter the air as a gas. The speed at which evaporation occurs depends on the kind of liquid, the temperature of the liquid, and the amount of liquid vapor above the liquid.

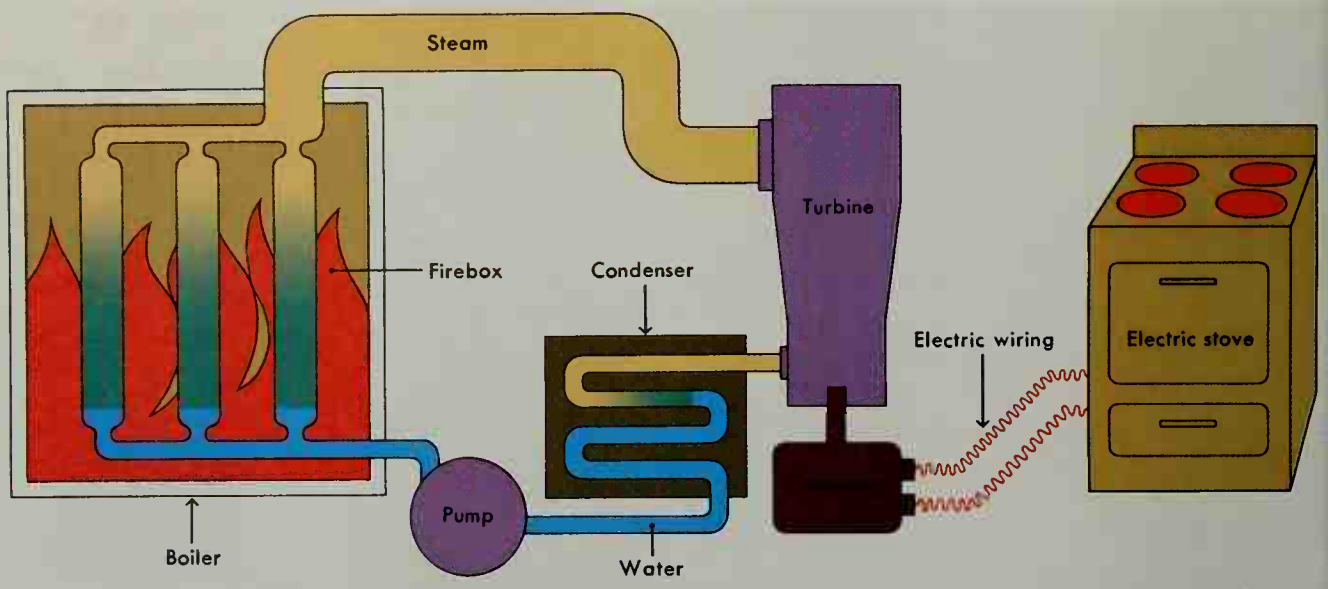
The heat needed to change a material from a solid to a liquid or from a liquid to a gas is called *latent heat*. It must be removed to change a gas back to a liquid or a liquid back to a solid. That is, 540 calories of heat must be removed from each gram of steam at 100° C to produce water, and 80 calories must be removed from each gram of water at 0° C to produce ice. The boiling and condensation points of a substance are at the same temperature, as are the melting and freezing points. The amount of heat that has entered or left a substance determines the substance's state.

Latent heat may also be associated with changes in the structure of the crystals that make up a solid substance. In general, much less latent heat is needed for such changes than for melting or vaporization.

Putting heat to work

Changing heat into motion. Mechanical energy and heat energy are related. For example, mechanical energy is changed into heat by friction between the moving parts of a machine. Heat energy, in turn, can be changed into mechanical energy by *heat engines*.

Heat engines can be divided into two groups: (1) *external-combustion engines* and (2) *internal-combustion engines*. External combustion engines produce hot gases that transfer heat energy to another fluid. The heat energy in this fluid, in turn, is changed into mechanical energy. Such engines include gas and steam turbines and reciprocating steam engines. Internal-combustion engines produce hot gases whose heat energy is changed directly into mechanical energy.



WORLD BOOK diagram

Heat energy can be changed into other forms of energy. This diagram shows how heat is changed into electricity. Heat in a boiler creates steam that turns a turbine. The turbine drives an electric generator. A condenser changes the steam back to water, and the cycle is repeated.

A steam turbine is a good example of an external-combustion engine. Heat from burning fuel or from a nuclear reactor changes water in a boiler to steam. Pipes carry the steam into the turbine, which has a series of bladed wheels attached to a shaft. The high-temperature steam expands as it rushes through the turbine and so pushes on the blades and causes them to turn the shaft. Steam leaving the turbine has a much lower temperature. The spinning shaft can drive an electric generator, move a ship's propeller, or do other useful work. See **Turbine** (Steam turbines).

An automobile gasoline engine is a good example of an internal-combustion engine. The burning of gasoline in the cylinders of the engine produces hot gases. The gases expand and push down the pistons in the cylinders. The motion of the pistons moves other parts of the car that turn the car's wheels. See **Gasoline engine.**

Refrigeration. The temperature of an object can be lowered by bringing it in contact with a colder object. The temperature difference causes heat to flow from the warmer object into the colder one. For example, ice put in an insulated chest keeps food cold by removing heat from it. A way to remove heat from an object without using a colder object is *mechanical refrigeration.*

Mechanical refrigeration works by changing a substance called a *refrigerant* from a gas to a liquid and back to a gas again. In a refrigerator, for example, a compressor squeezes a gaseous refrigerant into a small space. The compression reduces the refrigerant's disorder so much that it becomes a liquid. The compressed liquid refrigerant then expands at a valve leading to pipes in the insulated part of the refrigerator. As the pressure falls, so does the temperature, and the refrigerant absorbs heat from the foods in the refrigerator. As heat flows out of the foods, their temperature falls. The warmed refrigerant becomes a gas and then flows through pipes back to the compressor. There, the refrigeration cycle begins again. See **Refrigeration** (Mechanical refrigeration).

Theoretically, the lowest temperature a substance can have is *absolute zero,* which is −459.67° F., or −273.15° C. At this temperature, matter would have the least possible internal energy and almost no disorder. See **Absolute zero.**

Learning about heat

The caloric theory of heat. Until the late 1700's, many scientists believed that heat was an invisible fluid called *caloric.* They thought an object became warm when caloric flowed into it and grew cold when caloric flowed out of it. Because objects weighed the same whether they were hot or cold, the scientists reasoned that caloric had no weight and therefore could not be matter.

Near the end of the 1700's, the work of two men raised questions about heat that the caloric theory could not answer. In 1798, the American-born scientist Benjamin Thompson, also known as Count Rumford, observed the manufacture of cannons in Munich, Germany. He noted that the drills used to bore the cannons produced frictional heat even after the drills became dull and no longer cut out metal. The caloric theory could not account for the release of heat unless a drill actually cut metal. Yet an unlimited quantity of heat resulted as long as a drill turned against metal.

In 1799, the British chemist Sir Humphry Davy melted two pieces of ice by rubbing them together in a container at a temperature below the freezing point of water. Again, the caloric theory could not account for the heat produced. Thompson's and Davy's observations

raised doubts about the caloric theory. But no one proposed another explanation of heat.

Heat and energy. The idea that heat is a form of energy was proved during the mid-1800's. The proof was developed largely by three men—Julius Robert von Mayer, a German physician and physicist; Hermann von Helmholtz, a German physicist; and James Prescott Joule, a British physicist.

Mayer observed that people in warm and cold climates needed different amounts of food energy to maintain their normal body temperature. He published his findings in 1842, but they did not receive scientific recognition for many years. In 1847, Helmholtz published a work on heat and energy. He stated that heat is a form of energy, and the idea won rapid acceptance.

During the 1840's, Joule measured the amount of mechanical energy needed to raise the temperature of a certain quantity of water. The relationship between mechanical energy and heat energy is called the *mechanical equivalent of heat.* Joule's early experiments showed that 838 foot-pounds of mechanical energy produced 1 Btu of heat. Later scientists made more precise measurements. They found that the mechanical equivalent of heat was 778 foot-pounds per Btu, or, in the metric system, 4.184 joules per calorie. The joule was named for James Prescott Joule.

Thermodynamics is the study of the relationship between heat and other forms of energy. It is based on three *laws* (principles).

The first law of thermodynamics is the law of conservation of energy. It states that energy is never created or destroyed. Energy may change form—for example, from internal energy to mechanical motion—but the total quantity of energy in any *system* (group of things) remains the same.

According to the second law, all *spontaneous* (natural) events act to increase the entropy within a system. Until a system reaches its maximum entropy, it can do useful work. But as a system does work, its entropy increases until the system can no longer perform work.

The third law of thermodynamics concerns absolute zero. It states that it is impossible to reduce the temperature of any system to absolute zero. Ared Cezairliyan

Study aids

Related articles in *World Book* include:

Biographies

Clausius, Rudolf J. E.
Davy, Sir Humphry
Gibbs, Josiah W.
Helmholtz, Hermann L. F. von
Joule, James P.
Kelvin, Lord
Mayer, Julius R. von

Other related articles

Absolute zero
Boiling point
British thermal unit
Calorie
Celsius scale
Coal
Combustion
Cryogenics
Electricity
Energy
Entropy
Evaporation
Expansion
Fire
Friction
Fuel
Gas (fuel)
Heating
Infrared rays
Insulation
Metabolism
Molecule
Nuclear energy
Nuclear weapon
Perpetual motion machine
Petroleum
Solar energy
Steam
Sublimation
Sun
Temperature
Thermocouple
Thermodynamics
Thermometer

Outline

I. Sources of heat
A. The sun
B. The earth
C. Chemical reactions
D. Nuclear energy
E. Friction
F. Electricity

II. What heat is
A. Temperature and heat
B. Disorder

III. How heat travels
A. Conduction
B. Convection
C. Radiation
D. Insulation

IV. What heat does
A. Changes in temperature
B. Changes in size
C. Changes in state

V. Putting heat to work
A. Changing heat into motion
B. Refrigeration

VI. Learning about heat
A. The caloric theory of heat
B. Heat and energy
C. Thermodynamics

Questions

What was the *caloric* theory of heat?
Why do bridges and buildings have *expansion joints*?
How does heat create disorder in an object?
In what three ways does heat travel?
What is our most important source of heat?
What is specific heat?
What is the basic difference between temperature and heat?
How does insulation stop heat from traveling by convection?
What do *heat engines* do?
In what ways may the addition or removal of heat change a substance?

Additional resources

Darling, David J. *Between Fire and Ice: The Science of Heat.* Dillon Pr., 1992. Younger readers.
Gardner, Robert, and Kemer, Eric. *Science Projects About Temperature and Heat.* Enslow, 1994. Younger readers.
Goldstein, Martin and Inge F. *The Refrigerator and the Universe: Understanding the Laws of Energy.* Harvard Univ. Pr., 1993.
Jiji, Latif M. *Heat Transfer Essentials.* Begell Hse., 1998.

Heat exhaustion. See Hyperthermia; First aid (Heatstroke and heat exhaustion).

Heat index, or HI, is a measure of how hot the air feels. In the United States, the National Weather Service uses the HI to alert the public to the dangers of extremely hot and humid weather. The higher the HI, the greater is the likelihood that people will develop heat-related illnesses. The heat index has replaced an older measure, the temperature-humidity index.

The HI is measured in Fahrenheit degrees, but takes into account the effects of both temperature and *relative humidity.* Relative humidity is the amount of water vapor in the air at a certain temperature, compared with the maximum amount possible at that temperature. HI values are for air in the shade in which a light wind is blowing. Exposure to direct sunshine can increase the HI up to 15 °F. Strong winds also present an extra hazard, especially when the air is hot and dry.

The National Weather Service alerts the public when it expects the heat index to be higher than 105 to 110 °F for at least two successive days. The exact HI chosen depends on the local climate. At such times, the Weather

Dangers of a high heat index

Heat-related illness grows more likely as the heat index rises. To determine the index, use the chart in this article.

WORLD BOOK chart

Heat index	Possible heat disorders for people in higher risk groups
130 °F or higher	Heatstroke or sunstroke highly likely with continued exposure.
105 to 130 °F	Sunstroke, heat cramps, or heat exhaustion likely, and heatstroke possible, with prolonged exposure or physical activity.
90 to 105° F	Sunstroke, heat cramps, or heat exhaustion possible with prolonged exposure or physical activity.
80 to 90 °F	Fatigue possible with prolonged exposure or physical activity.

Service begins to include the HI in weather forecasts. It also issues statements describing hazards associated with the HI values, explaining how to reduce the risk of heat-related illness, and indicating what kinds of individuals are at high risk. High-risk groups include elderly people; small children; chronic invalids; those on certain medications, especially tranquilizers; overweight individuals; and alcohol abusers.

During severe heat waves, the Weather Service helps the news media and local and state health officials issue civil emergency messages. These alerts include detailed information on heat disorders and how to reduce risk, as well as names and telephone numbers to contact for help.

To find the HI, use the heat index chart in this article. Suppose, for example, the temperature is 95 °F and the relative humidity is 55 percent. First, find the "95" in the column at the left of the chart. Then follow the row of numbers to the right until you reach the number above the "55" in the bottom row. You will find that the heat index is 110 °F. Margaret A. LeMone

Heat pipe is a device that transfers large amounts of heat from one place to another with only small amounts of heat loss. Heat pipes can transport much more heat per unit area than the best metal conductors, including copper and silver. Unlike most heat transfer devices, they require no external power source. This feature makes them more energy-efficient and more economical.

Heat pipes are used to remove waste heat from certain types of electronic equipment and industrial machinery. In many cases, they carry this heat to another place where it can be used. Some air-conditioning and heating systems employ heat pipes to regulate temperature. Heat pipes also have been used for such purposes as controlling the temperature in spacecraft and transporting heat from solar energy collectors.

A heat pipe consists of a metal tube that is sealed at both ends and lined with a porous material. The lining, called the *wick,* holds a liquid, such as water, methanol, or molten lithium. This liquid is known as the *working fluid.* It absorbs heat from a heat source at one end of the tube and vaporizes. The vapor flows out of the wick and builds up pressure at the hot end of the tube. This pressure causes some of the vapor to travel to the cooler end of the tube. There the vapor condenses as it cools, transferring its heat through the tube wall. The liquid returns to the warmer end of the tube through the wick as a result of *capillarity* (see **Capillarity**).

The temperature of the heat delivered by a heat pipe is roughly equal to the working fluid's *boiling point,* the temperature at which the liquid bubbles and vaporizes. The boiling point remains constant as long as the atmospheric pressure does not change, so a heat pipe provides precise temperature control. Thomas T. Liao

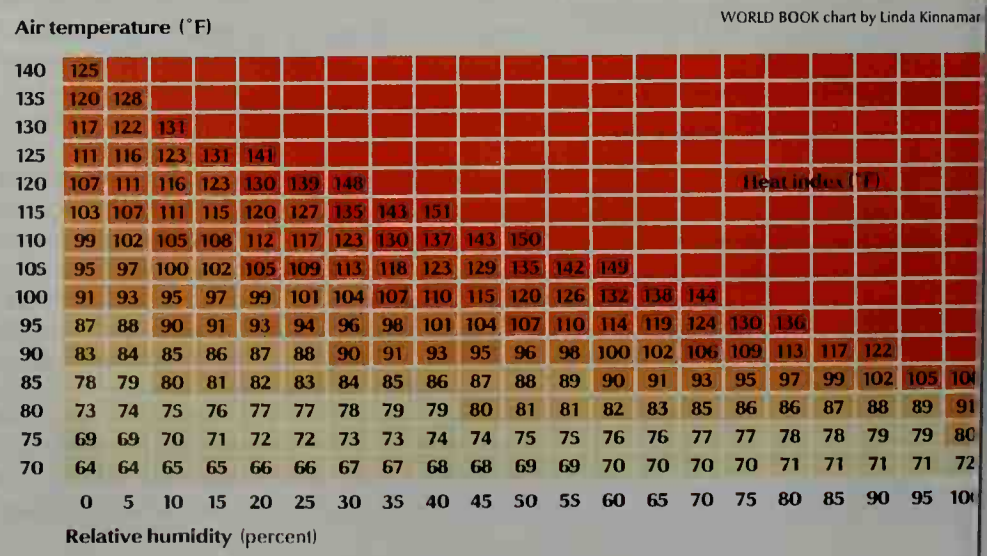
Heat pump is a device that takes heat from one area and delivers it to another area at a higher temperature. In heating a building, a heat pump absorbs heat from outside the building and delivers it inside. The same heat pump can also cool a building by pumping heat from the inside to the outside.

The fluid that circulates through a heat pump is called a *refrigerant.* For heating, a cold refrigerant first flows through coils of pipe that are exposed to an outside heat source. The heat source may be outside air, well water,

Heat index chart

The chart at the right shows how the combination of temperature and relative humidity affects people. As the temperature and relative humidity rise, the heat index increases. The higher the index, the greater the likelihood that people will develop heat-related illnesses. The risk of illness is low when the index is below 80 °F. To determine the risk at a higher index, see the table "Dangers of a high heat index" in this article.

WORLD BOOK chart by Linda Kinnamar



or the ground—all of which contain heat even at 0 °F (−18 °C). The refrigerant absorbs heat from these sources, boils, and becomes a vapor. The vapor then goes to a compressor that increases its temperature and pressure. The heated vapor then passes through an inside coil that resembles an automobile radiator. The vapor gives up some of its heat to room air that is circulating through the inside coil. When the vapor loses its heat, it condenses and turns back into a liquid. The liquid refrigerant then passes through a pressure-reducing restrictor, and the liquid becomes cold again. The cycle is repeated as the refrigerant circulates again through the coils of pipe and picks up heat from the heat source.

For cooling purposes, valves reverse the direction of the refrigerant flow. The refrigerant vapor flows from a compressor at high temperature and pressure through the outside coils. At this point, water, earth, or outside air absorbs heat from the hotter refrigerant. The refrigerant condenses and then passes through the restrictor, which lowers its pressure and thus decreases its temperature. The refrigerant absorbs heat from the room air in the inside coil. The warm refrigerant, now a vapor again, returns to the compressor and the cycle is repeated. Heat pumps are controlled by thermostats that sense the temperature of the room and turn the compressor on and off. Evan Powell

See also **Air conditioning**; **Heating** (diagram: Heat pump); **Refrigeration**.

Heat rash. See Prickly heat.

Heath, *heeth,* also called *heather,* is a type of low evergreen shrub that grows on moors in the United Kingdom, other parts of Europe, and Africa. *Heath* also means an open area where few plants except these shrubs grow.

There are over 600 kinds of heather. Most species are native to Africa. *Scotch heather* is common on moors in Europe. It is also called *ling.* This plant has a low, grayish, hairy stalk, broomlike branches, and leaves like needles. Its tiny purple-rose blossoms are shaped like bells, and grow in long clusters called spikes.

Heather bells are often mentioned in Scotch songs and stories. They are the flowers of either the *cross-leaved heath* or the *twisted heath* of the United Kingdom and Ireland. Many African heathers also have colorful blossoms.

In European countries, heather is used to make brooms and brushes. The trailing shoots are woven into baskets. Briarwood, used for pipes, comes from the roots of a heather common in France. Some people in Scotland build the thatched roofs of their houses from heather. In some places, a liquid made from heather is used in tanning leather. Domestic animals are fed young heather shoots. Heather is also valuable because it makes up a large part of the material that fills peat bogs. Peat makes an important low-grade fuel in some European countries. Many birds also eat heather seeds.

True heather is not common in the United States, but many plants of the United States belong to the heath family. Among them are the azalea, blueberry, cranberry, huckleberry, manzanita, rhododendron, and trailing arbutus. James L. Luteyn

Scientific classification. Heath is a member of the heath family, Ericaceae. The cross-leaved heath is *Erica tetralix.* The twisted heath is *E. cinerea.* Heather is *Calluna vulgaris.*

Related articles in *World Book* include:

Arbutus	Huckleberry	Manzanita
Azalea	Indian pipe	Mountain laurel
Blueberry	Labrador tea	Rhododendron
Brier	Lingonberry	Sourwood
Cranberry	Madroña	Wintergreen

Heath, *heeth,* **Edward** (1916-), a member of the Conservative Party, served as prime minister of the United Kingdom from 1970 to 1974. Under Heath's leadership, the United Kingdom joined the European Community, an economic organization that was incorporated into the European Union in 1993. Strikes and inflation led Heath to call for elections in 1974. The Conservatives failed to win a parliamentary majority, and Heath resigned from office.

Heath was first elected to the House of Commons in 1950 and quickly became a leader. By 1955, he had become chief party whip, responsible for party conduct in the House. Heath became minister of labour in 1959. He was president of the Board of Trade in 1963 and 1964.

Heath became head of the Conservative Party in 1965. He was the first Conservative leader ever elected by party members in the House of Commons. Previous leaders had been chosen by small groups of influential party members. Heath served as party leader until 1975, and he remained in the House of Commons until 2001. He sometimes openly criticized Conservative Prime Minister Margaret Thatcher, who held office from 1979 to 1990. He retired from the House of Commons in 2001.

Unlike most Conservative Party leaders, Heath inherited neither social position nor wealth. He was born on July 9, 1916, in Broadstairs, Kent, England, where his father was a carpenter. Edward Richard George Heath attended a state-supported secondary school and won a scholarship to Oxford University. During World War II (1939-1945), Heath rose from private to lieutenant colonel in the British Army. Heath was made a Knight Companion of the Order of the Garter in 1992. Richard Rose

Heath hen. See Prairie-chicken.

Heather. See Heath.

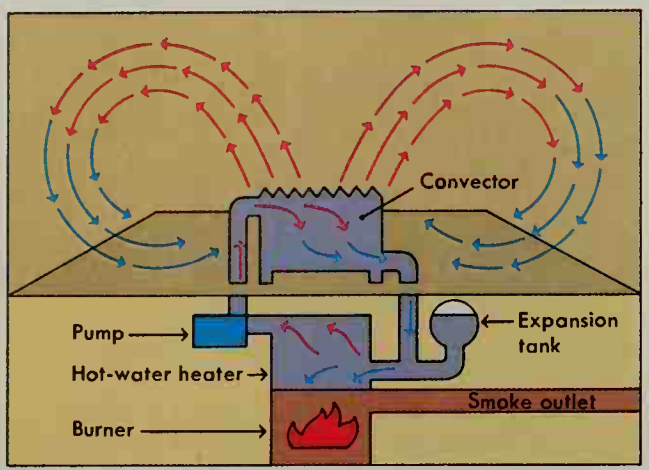
Heating is the supplying of heat to a building, a vehicle, or other enclosure to make the occupants more comfortable. This article deals with the heating of houses and other buildings.

Most people feel comfortable in a room with a temperature of 68 to 75 °F (20 to 24 °C). The humidity in a room also affects comfort. If two rooms have the same temperature but different humidity, most people will feel warmer in the room with the higher humidity. An indoor *relative humidity* of 30 to 60 percent is the most comfortable for most people (see **Humidity**).

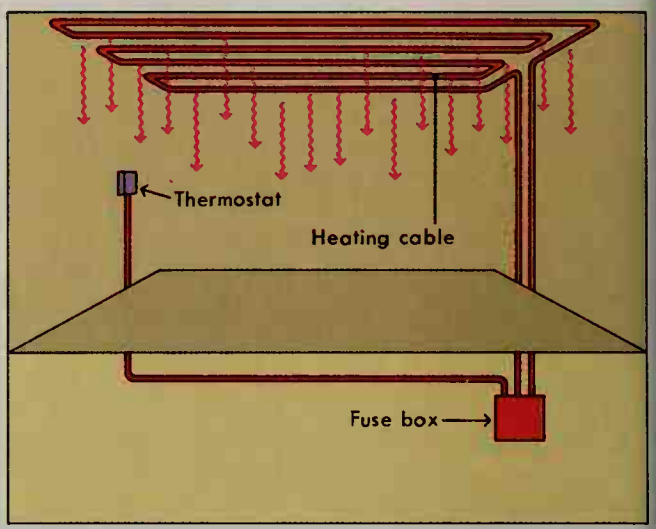
The temperature in a home can be lower without sacrificing comfort for some people if moisture is added to the air with a device called a *humidifier.* However, adding the moisture may require more energy than merely raising the temperature.

There are two kinds of heating equipment: (1) central heating systems and (2) local heating devices. A central system generates heat for an entire building at a central place, then delivers the heat where it is needed. A local heating device generates heat for only one part of a building. Local devices include fireplaces, wood-burning stoves, and room heaters. Central heating sys-

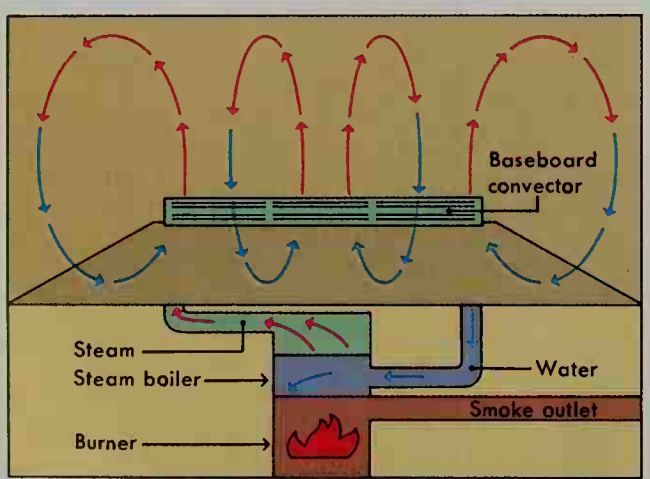
Basic heating systems



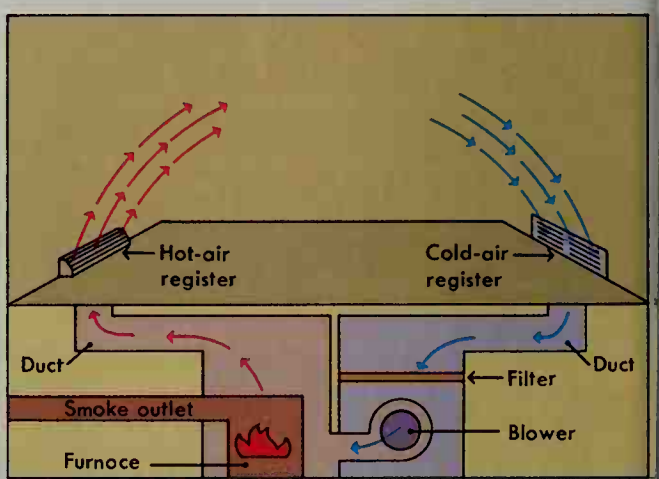
Hot-water heating. Fuel is burned in a hot-water heater to heat water. A pump forces the hot water through pipes to a convector in each room being heated. The water gives up its heat to the room and returns to the boiler through another pipe.



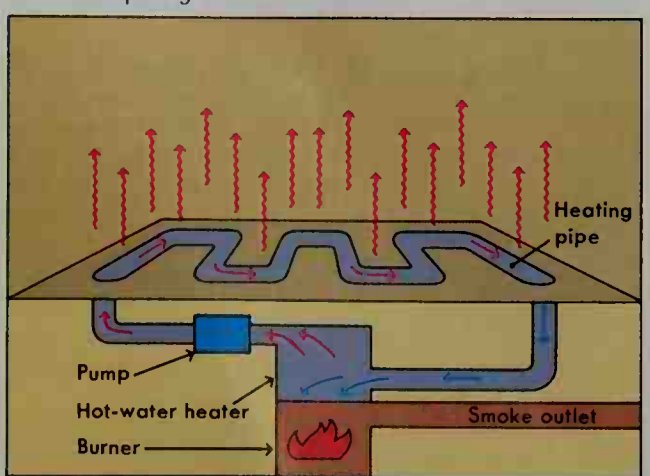
Radiant electric heating uses a cable that produces heat from electricity. The cable radiates heat to the room and may be installed in the ceiling or floor or along the baseboard. A thermostat controls the amount of heat produced by the cable.



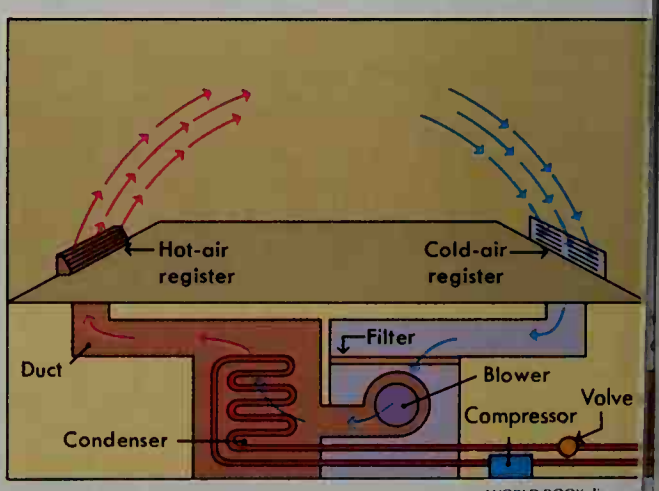
Steam heating works much like hot-water heating, except that water changes to steam in a boiler. The steam passes through pipes to convectors, where it gives up its heat to the room and becomes liquid again. The water then flows back to the boiler.



Warm-air heating. A furnace heats the air, and a blower forces it through a duct to a register that opens into the room being heated. Cool air returns to the furnace through another duct. A filter removes dust from the air as it circulates.



Radiant hot-water heating. Water is heated in a boiler and pumped through a continuous coil of pipe in the floor of the room being heated. Heat radiates from these pipes and keeps the room temperature nearly the same from floor to ceiling.



Heat pump. A heating system that uses a heat pump operates much like a warm-air system. But the heat pump uses a condenser, evaporator, compressor, and other equipment to get heat from outside and "pump" it into the building.

tems are much more common in industrialized countries than in developing nations.

Central heating systems

Most central heating systems serve only one building. However, some systems heat a group of buildings, such as those at a college, a military base, or an apartment complex.

Central heating systems have automatic controls, with a device called a *thermostat* to regulate the temperature of the rooms heated by the system. A person sets the thermostat at the desired temperature. The thermostat turns the system on when the temperature drops below the setting, and turns the system off when the temperature rises above the setting.

Another automatic control turns off the central heating system if any part of it becomes dangerously overheated. Still another control prevents the system from starting unless it can start safely.

The major kinds of central heating systems include (1) warm-air heating, (2) heat pumps, (3) steam and hot-water heating, (4) electric radiant heating, and (5) solar heating. Warm-air heating and heat pumps are *direct* systems—that is, they circulate warm air throughout the area being heated. The other major heating systems are *indirect.* They run steam or hot water through pipes, or electric current through cables, to radiators that give off heat.

Warm-air heating. A warm-air heating system warms the air in a furnace and then forces it through a system of ducts to each room. Another system of ducts carries air from the rooms back to the furnace. An electrically driven blower in the furnace moves the air through the ducts, and filters remove dust particles from the air.

The adaptability of warm-air systems makes them the most widely used form of central heating in North American homes. A forced warm-air system with a humidifier, for example, can increase humidity throughout the home. In hot weather, the system's ducts and blower can be used as part of a central air-conditioning system.

Heat pumps. Even in cold weather, the earth or outside air contains heat that can be used to warm a building. A device called a *heat pump* takes heat from the outside air and brings it inside. In winter, a heat pump circulates a liquid refrigerant through a coil, called an *evaporator,* outside the building. As the cold liquid passes through the coil it picks up heat from the outside air or earth, boils, and becomes a vapor. The vapor then passes into a compressor. The compressor increases the temperature and pressure of the vapor. Then the hot vapor passes through an inside coil, called a *condenser,* where it heats the air and condenses into a hot liquid. The hot liquid then goes through a pressure-reducing valve and becomes cold again. Finally, the refrigerant is forced back to the outside coil and the cycle begins again. Heat pumps are built into many warm-air heating systems, serving as a source of heat.

During the summer, heat pumps reverse their operation. They cool the building by pumping heat from the inside to the outside.

Steam and hot-water heating systems. Steam or hot-water heating systems are used in many large buildings. These systems cost more than warm-air systems, but they have certain advantages. The pipes carrying steam or hot water are smaller than warm-air ducts. Automatic valves can control the amount of hot water or steam flowing to convectors more easily than they can control warm air. Thus, it is easier to control the temperature in different rooms with these systems than with warm-air heating.

A steam heating system requires a boiler, and a hot-water heating system has a hot-water heater. Fuel burning in the boiler or heater produces heat for the system. The system also has a network of pipes and convectors. In steam heating, a pump or gravity forces the condensed steam back to the boiler. In hot-water heating, a pump circulates the water through the system.

The convectors of a steam or hot-water system give off their heat by *convection* and *radiation.* In convection, the convector heats the surrounding air. In radiation, the convector sends out *infrared rays,* which heat objects in the room. Infrared rays are much like light waves but are invisible. Infrared rays can go through air without heating it. However, when the rays strike an object such as a table or a chair—or even a person's skin—they heat the object.

The amount of heat that is given off by radiation depends on the temperature and surface area of the convector. With lower temperatures typical of hot-water heating, more heat is delivered by convection than by radiation. The amount of heat that is given off by a convector depends upon its shape and the amount of exposed metal surface. The more metal that is exposed, the more heat is given off.

One difficulty in heating with high temperature convectors alone stems from the fact that warm air rises. Thus, the air near the ceiling becomes warmer than the air in other parts of the room. For example, the air at knee height may be 60 °F (16 °C), the air at the breathing level may be 68 °F (20 °C), and the air at the ceiling may be 76 °F (24 °C). The air at the floor level may be only 53 °F (12 °C). Such a floor temperature is too low for comfort. If an attempt is made to raise the temperature of the floor, the average room temperature increases and the upper parts of the room become uncomfortably warm.

Radiant heating equalizes temperature within a room. A loop of hot-water pipe is installed in the ceiling or floor. Heat leaves the pipe by radiation, which does not directly raise the temperature of the air. Because radiation affects only the objects it strikes, it produces more uniform heating than convection does.

Radiant heat provides comfort at a lower room temperature than other heating systems. Such heat warms the surface of the skin and clothing and makes people comfortable even in a cool room.

Radiant heating also may be installed along the baseboards of a room. One system uses a metal shield about 6 inches (15 centimeters) high to cover a hot-water pipe that runs close to the floor. Such a system distributes heat evenly. All radiant heating systems limit the temperature difference between the floor and the ceiling to only a few degrees.

Electric radiant heating differs from other central heating because it requires no combustion of fuel in the building being heated. Instead, the electric power comes from a plant that may be far away.

An electric heating unit uses *resistance heating*. An electric current passes through a material that strongly resists the flow of current. As a result, the current heats the material.

The heating units may be installed in the ceiling, in the floor, or along the baseboards of a room. Thermostats in the various rooms of a house can control electric heating units to regulate room temperature individually.

Solar heating uses sunlight to heat devices called *solar collectors*. Fluid inside the collectors flows to a heat exchanger, where the fluid transfers its heat to water. The heated water is used to heat the building as in other hot-water systems. See **Solar energy** (Solar heating).

Sources of heat

Most homeowners heat with gas, oil, or electric power. At one time, many private homes were heated with coal. But gas, oil, and other fuels have largely replaced coal in homes because they are more convenient and produce less pollution.

Gas produces heat with little air pollution. Nearly all the gas used for heating homes is either natural gas or *LPG* (liquefied petroleum gas). Natural gas comes from underground rock formations, as does oil. Most natural gas reaches homes through pipelines.

Many people who live in mobile homes or in farm areas or other places far from gas pipelines use LPG. This fuel is produced by pressurizing certain compounds in natural gas or certain gaseous compounds taken from petroleum. Farm suppliers deliver LPG to the users in small pressurized containers. A valve feeds LPG from the container into a pipe. When the LPG leaves the container, it changes back into a gas. It then flows through the pipe to a furnace.

Gas is simple to burn. The furnace pipes the fuel to individual burners, where combustion takes place.

Oil. Fuel oil used for home heating comes from the refining of petroleum. Local trucks deliver the oil to homes, where it is stored in tanks until used. A home oil furnace has either a *pot-type* (or *vaporizing*) burner or a *gun-type* (or *atomizing*) burner. In a pot-type burner, the fuel flows into a shallow depression in the bottom of the furnace. In a gun-type burner, the oil is sprayed through a nozzle under air pressure. The burner uses an air pump to vaporize the fuel. The added air makes the oil burn more efficiently.

Electric power provides convenient, comfortable heating. Resistance electric heating offers such major advantages as cleanliness, safety, and low maintenance expense. But it is less efficient and usually costs more than other heating methods.

Electric storage heaters help reduce costs. These heaters use electric power to generate large amounts of heat during late-night hours when rates are lower. The units store heat in a solid or liquid material. Many use bricks for this purpose. During the daytime, the units use the stored heat to maintain comfortable room temperatures without additional electric power.

Most of the electric power plants in the world are much less efficient than are oil or gas heaters in the home. Electric power plants that burn gas, oil, or coal provide approximately 65 percent of the world's electric power. Such plants use about three units of energy for each unit of heat that is delivered to the home.

A gas or oil heating system in the home can convert 70 to 90 percent of the energy it uses into heat. If electric power is to be used, builders recommend an electric heat pump because it delivers about three units of heat for each unit of energy it uses.

Coal. People in many areas, especially in Asia and Europe, use coal to heat homes and buildings. The burning coal either heats air that is forced through ducts, or it is used to make steam that flows to convectors. The rising cost of gas and oil has led some factories and commercial buildings to switch to coal.

Coal for heating is available in several grades, depending on its heating capability and carbon content. The two most common types of coal used for heating are *anthracite* (hard coal) and *bituminous* (soft coal). Anthracite produces less smoke and sulfur dioxide when burned than does bituminous coal.

Local heating devices

Local heating devices are still in common use in developing countries. Such devices include fireplaces, wood-burning stoves, and room heaters.

Fireplaces. The earliest type of local heating device was the open fire within an enclosure, such as a cave or a tent. Such a fire is not satisfactory because the area soon becomes filled with smoke. In addition, an open fire without a chimney lacks enough draft to burn brightly.

If a fireplace is put at one side of a room and provided with a chimney, the smoke and combustion gases will pass up the chimney. The chimney provides a draft by which the air enters the front of the fireplace and passes up the chimney to aid the burning of the fuel. However, this draft reduces the energy efficiency of a fireplace.

A typical fireplace allows enough warm air to escape through the chimney to empty an average room every few minutes. Because of this air leak, a fireplace may contribute little to the heating of a room in a house that has a central heating system. Both the fireplace and the central heating warm the room. However, the amount of heat provided by the fireplace may be only slightly larger than the amount of centrally provided heat that leaks out.

Wood-burning stoves were widely used for cooking and heating before the development of gas and electric ranges and central heating systems. In the 1970's, the stoves again became popular in some rural areas, where wood is plentiful. In such areas, the stoves may provide cheaper heat than do oil burning systems. However, smoke from wood-burning stoves pollutes the air.

Most wood-burning stoves are made of heavy cast iron or steel. Air inlets in the front of the stove control the draft and help burn wood more efficiently than in an open fireplace. When the stove becomes hot, it holds heat better than a fireplace does. *Franklin stoves* resemble the stove created by the American inventor and statesman Benjamin Franklin in the 1740's. These stoves have doors in the front, so they can function as a stove or fireplace. *Fireplace inserts* are stoves that fit into a fireplace.

Room heaters. Some room heaters burn gas to produce heat. These can be placed in a corner of the room

and used with a fan to circulate the air. Such heaters should not be used without adequate venting to the outside because combustion gases can harm the occupants of the room. Other room heaters burn kerosene and also must be vented.

Electric room heaters pass an electric current through a series of wires. These wires strongly resist the flow of current and therefore become red-hot. Such electric heaters are used in bathrooms, bedrooms, workshops, and other spaces.

Most local sources of heat are hotter than steam and hot-water radiators. For this reason, they produce a larger proportion of radiant heat. When such large amounts of radiant heat are used, the temperature of the air in the room need not become so high. For example, a resistance-type electric heater called a *quartz heater* warms anyone in the path of its heat rays. But the heat rays do not warm the air through which they travel.

James E. Hill

Related articles in *World Book* include:

Air conditioning	Fuel	Heat pipe	Radiator
Coal	Furnace	Heat pump	Solar energy
Electricity	Gas	Insulation	Thermostat
	Heat	Petroleum	

Heatstroke. See Hyperthermia.

Heaven, in the teachings of many religions, is the place or spiritual state in which God, gods, or spirits abide. According to most of these religions, the souls of people who have been faithful to God go to heaven as a reward. Many scriptures describe heaven as a place of dazzling beauty and perfection.

The major Western religions—Christianity, Islam, and Judaism—teach that heaven is eternal and dominated by God's presence. Most Christians believe the supreme reward of heaven is the happiness of being close to God. For followers of Islam, heaven is a refreshing garden where the face of God is seen. Jewish writings refer to the highest heaven as the upper part of the universe and describe the grandeur of the heavens. Many Jews believe a future *Messiah* will establish a kind of heavenly kingdom on earth (see Judaism [The Messiah]).

According to two Eastern religions, Buddhism and Hinduism, heaven has many levels. These levels represent degrees of spiritual purity. Buddhists and Hindus believe that if they perform good deeds, their souls will ascend to such levels. But heaven is not eternal. The most advanced believers pass beyond heaven to the eternal states of nirvana and buddhahood. The rest return and are reborn. J. H. Charlesworth

See also Religion (A doctrine of salvation); Elysium; Nirvana; Paradise; Valhalla.

Heaves, also known as *broken wind,* is a lung disease of horses. Horses suffering from heaves have difficulty exhaling and may develop a chronic cough. Their nostrils dilate and their sides heave as they struggle to breathe.

Heaves may result from any of a number of disorders that affect exhalation. The most common causes are allergies, prolonged inflammation of the lung airways by dust or mold, ballooning and rupturing of the tiny air sacs in the lungs, and viral or bacterial infections of the airways. Dietary factors also may be involved. Heaves may be mild and cause minor problems, or it may disable the horse completely. Important preventive measures include providing horses with clean, high-quality feed and well-ventilated shelters free of dust and mold. To relieve symptoms of heaves, veterinarians prescribe rest, corticosteroids and other drugs, and control of the horse's feed and surroundings. Lawrence D. McGill

Heavy hydrogen. See Deuterium.

Heavy water (chemical formula D_2O or ^2H_2O) is water that contains the heavy isotope of hydrogen called *deuterium* (chemical symbol D) in place of ordinary hydrogen. The deuterium atom has a mass about twice as great as an ordinary hydrogen atom. Heavy water is also called *deuterium oxide.* Heavy water is useful in some kinds of nuclear reactors called *heavy water reactors.*

Because of the difference between the masses of the two kinds of hydrogen atoms, the physical properties of heavy water differ from those of ordinary water. Heavy water freezes at 3.82 °C (38.88 °F), rather than at 0 °C (32 °F). It boils at 101.42 °C (214.56 °F), rather than at 100 °C (212 °F). Seeds will not germinate in it, and animals cannot live in it. Heavy water was first separated from ordinary water in 1932 by Gilbert N. Lewis, a chemist at the University of California. Peter A. Rock

See also Deuterium (Properties); Nuclear energy (Power reactors); Urey, Harold C.

Hebe, *HEE bee,* was a goddess in Greek mythology who served nectar to the gods and goddesses on Mount Olympus. She was the daughter of Zeus, the king of the gods, and of the goddess Hera. The name Hebe comes from a Greek word meaning *youth* or *prime of life.* The nectar Hebe served was believed to keep the gods and goddesses youthful. After the hero Heracles (Hercules in Latin) was made a god, Hebe became his wife. See also Hercules. Jon D. Mikalson

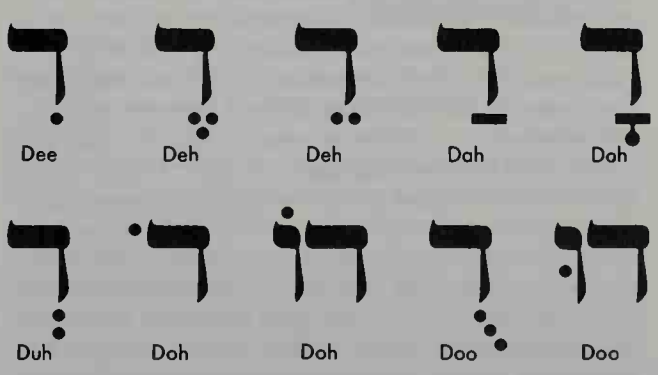
Hebrew Bible. See Bible.

Hebrew calendar. See Calendar (Hebrew calendar).

Hebrew language has been the language of the Jewish people throughout their history. It is one of the world's oldest living languages. The Hebrew Bible, or Old Testament, is the greatest work of the Hebrew language. Today, Hebrew is the main language of Israel, where more than 4 million people speak it.

Hebrew is a Semitic language and is thus derived from the same source as the Arabic, Amharic, Aramaic, and Akkadian languages. Like Arabic and Aramaic, Hebrew is written from right to left.

The Hebrew alphabet consists of 22 letters. Four of the letters have two pronunciations. Most of the letters are consonants, but some can represent a consonant or



Hebrew vowels are indicated by vowel points placed with a consonant. Some vowel points are shown above with Daleth.

The Hebrew alphabet has 22 letters, shown here in alphabetical order from right to left, as Hebrew is written. The illustration shows 26 letters, because four letters have two forms—with or without a dot—that correspond to different pronunciations.

a vowel. Most vowel sounds are not normally written, but they may be indicated by a system of dots and lines, called *vowel points.* The Hebrew alphabet is also used to write other languages used by the Jews, such as Yiddish, Ladino, and Judeo-Arabic (see **Yiddish language**).

Most Hebrew words contain roots of three consonants. New words can be made by using the consonants of an existing word in a new way. For example, in the Bible the Hebrew word *miklat* means *refuge* or *shelter.* It has the root *k-l-t.* Later, words with the same root were created, including *taklit,* which means *phonograph record,* and *kaletet,* which means *cassette tape.*

Throughout history, different Jewish communities developed their own ways of pronouncing Hebrew words. In the United States, the two most common styles are the *Ashkenazic* and the *Sephardic.* Ashkenazic is based on German and Yiddish language traditions. Sephardic is similar to the Hebrew spoken in Israel.

Archaeologists have found Hebrew inscriptions that date as early as the 900's B.C. Later documents show that Hebrew continued to be the written and spoken language in what was then Judea until about A.D. 200. One such collection of manuscripts, known as the Dead Sea Scrolls, dates from the 200's B.C. Another example, a collection of Jewish laws known as the *Mishnah,* was written down between A.D. 70 and 200.

In A.D. 135, Roman armies killed or scattered the Jews of Judea and renamed it Palestine. As a result, a Hebrew-speaking community no longer existed by about 200. For almost 1,700 years, Hebrew was not used as a native language. It was used only in writing and scholarly discussion. But in this period, its vocabulary was expanded to express new concepts in philosophy and science. In the late 1800's, Jews from many nations began to settle in Palestine. Many started speaking Hebrew as their everyday language. Their children learned Hebrew as their native tongue. Robert D. Hoberman

See also **Hebrew literature.**

Hebrew literature consists of stories, poems, religious studies, and other works written in Hebrew, one of the oldest living languages. The Hebrew Bible, which Christians call the Old Testament, is the greatest product of Hebrew literature. Through the centuries, many Hebrew works were written by Jews living in Europe. Today, Israeli writers produce most Hebrew literature.

Early works. The first known works of literature written in Hebrew were Biblical poems. They include "The Song of Miriam" (Exodus 15:21), which may date from the early 1200's B.C., and "The Song of Deborah" (Judges 5), composed in the 1100's B.C.

The other major product of early Hebrew literature was the Mishnah, a written version of traditional Jewish oral law. The Mishnah, which was written down about A.D. 200, forms part of the Talmud. Next to the Bible, the Talmud is the most sacred book of the Jewish religion (see **Talmud**). By the 500's, great verse prayers called *piyyutim* were being composed for religious services.

Medieval works. During the Middle Ages, such travelers as Eldad Ha-Dani and Benjamin of Tudela wrote Hebrew accounts of their journeys. *Yosippon* (900's) and other anonymous works combined Jewish history with legends. Such works of the 1100's and 1200's as the *Book of Delight* by Ibn Zabara and *Tahkemoni* by Judah Alharizi reflect migrations of Jews to many countries.

Scholars consider the period in Spain from the 900's to the 1400's to be a golden age of Hebrew literature. Great Hebrew poetry of the time included the religious poems of Solomon ibn Gabirol and Judah Halevi's *Songs of Zion.* The Jewish philosopher Moses Maimonides's influential *Guide for the Perplexed* also appeared during this period. Originally written in Arabic, the book was quickly translated into Hebrew.

During the Middle Ages, the Jews suffered much persecution. Some Hebrew authors tried to understand Jewish suffering by examining the relationship between God and human beings. Much of the literature of these writers formed part of the Jewish mystical tradition called the *Kabbalah.* The *Zohar (Book of Splendor),* written partly in Hebrew, is the greatest work of Kabbalist literature. It was probably written in the late 1200's by a Spanish Kabbalist named Moses de Leon.

Modern Hebrew literature, according to many scholars, began with the Hebrew cultural and literary movement called the *Haskalah* (Enlightenment) in the late 1700's. Followers of this movement encouraged Jews to abandon some traditional ways and to adopt aspects of modern Western culture. See **Haskalah.**

The first Hebrew novel, *Love of Zion* (1853), was written by Abraham Mapu. During the 1860's and 1870's, Yehudah Leib Gordon, Moshe Leib Lilienblum, and Peretz Smolenskin dominated Hebrew literature. Gordon wrote poetry on historical themes and on women's rights and other issues. Lilienblum's autobiography, *Sins of Youth* (1876), was widely read. Smolenskin was one of

the first Hebrew writers to promote the idea that the Jews were a nation, not just a religious group.

Another great author of the late 1800's was Shalom Jacob Abramovich. He wrote under the name of Mendele the Bookseller. Abramovich helped develop a modern Hebrew literary style that was precise and natural.

Starting in the 1880's, *Zionism,* the idea of establishing a national Jewish state, became an important force in Hebrew literature. Asher Ginzberg, also known as Ahad Ha-am, wrote philosophical essays on the proposed Jewish homeland. Many poems by Chaim Nachman Bialik show the excitement of the awakening of Jewish national feeling. Some of Shmuel Yosef Agnon's fiction describes the Jewish settlement in Palestine in the early 1900's. Other Hebrew authors of the early to mid-1900's include the poets Nathan Alterman, Uri Zvi Greenberg, Abraham Shlonsky, and Saul Tchernichovsky; and the prose writers Micha Yosef Berdyczewski, Yosef Haim Brenner, Haim Hazaz, and S. Yizhar.

A new generation of Hebrew writers began with the establishment of Israel in 1948. This new generation included the novelists Aharon Megged, Nathan Shaham, and Moshe Shamir; and the poets Yehudah Amichai, Amir Gilboa, and Haim Gouri. The novels *My Michael* (1968) and *Black Box* (1987) by Amos Oz and *The Lover* (1977) and *Mr. Mani* (1990) by A. B. Yehoshua describe life in the new nation. These works also explore such topics as conflict between parents and children and the rejection of some once-sacred ideals of Judaism and Zionism. Many Hebrew writers in the late 1900's dealt with the Nazi mass murder of Jews in the 1930's and 1940's, women's issues, and the hostility between Israelis and Arabs. Another important topic was the tension between Jews of European origin, called *Ashkenazim,* and Jews of Middle Eastern and Mediterranean origin, called *Sephardim.*

Hebrew literature today. Leading writers include Ruth Almog, Aharon Appelfeld, Yitzhak Ben-Ner, David Grossman, Amalia Kahana-Carmon, Etgar Keret, Savyon Liebrecht, Sami Michael, Yaakov Shabtai, David Shahar, Meir Shalev, and Tseruyah Shalev. Popular poets include David Avidan, Maya Bejerano, Erez Biton, Yitzchak Laor, Dan Pagis, Dalia Ravikovitch, Ronny Someck, Meir Wieseltier, and Yona Wallach. Stanley L. Nash

Related articles in *World Book* include:

Agnon, Shmuel Y.	Hebrew language	Mendelssohn, Moses
Bialik, Chaim N.	Kabbalah	Yiddish literature
Bible	Maimonides, Moses	Zionism
Halevi, Judah		

Hebrews. See Jews.

Hebrews, Epistle to the, is the 19th book of the New Testament. Although it is called an *epistle* (letter), it is really a type of religious essay. Its author is unknown. It was probably written during the persecution of Christians by Rome under the Emperor Domitian sometime between A.D. 81 and 96. The author tries to help his readers to remain faithful as Christians, despite persecution, in three ways. First, he praises the greatness of Christianity, mainly by showing that it is superior, in his view, to Judaism. Second, he presents Jesus as an example of being perfected through suffering. Third, he warns of the spiritual consequences to Christians of abandoning their faith. Terrance D. Callan

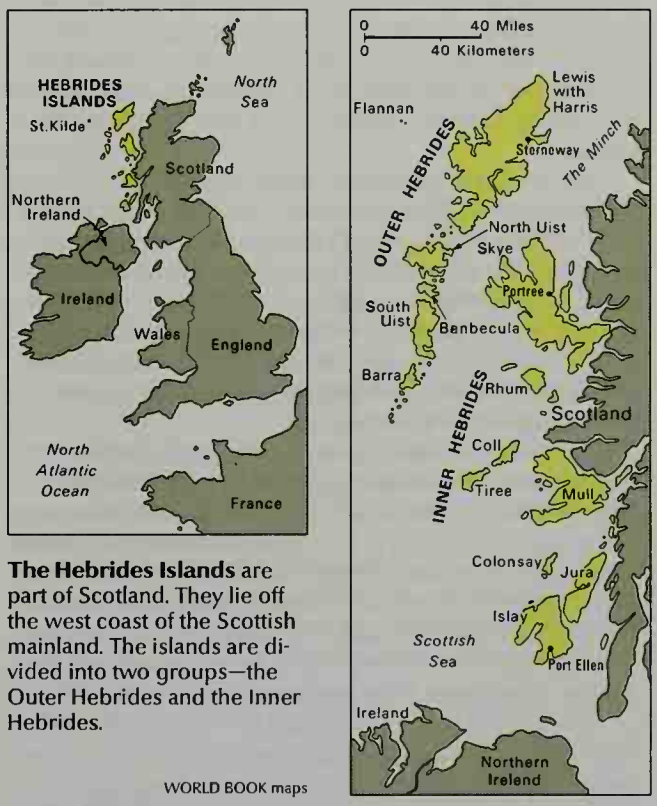
See also **Bible** (Books of the New Testament).

Hebrides, *HEHB rih DEEZ,* are a group of Scottish islands that lie northwest of the mainland of Scotland. The Hebrides consist of about 500 islands and have an area of about 2,600 square miles (6,730 square kilometers). The largest islands are (1) Lewis with Harris and (2) Skye. Many of the islands are tiny and uninhabited.

The Hebrides are divided into two groups of islands, the Inner Hebrides and the Outer Hebrides, also called the Western Isles. The Inner Hebrides, which lie closest to the mainland, feature spectacular mountain scenery. The Cuillin Hills, on Skye, are especially noted for their rugged beauty. The islands of the Outer Hebrides have large areas of barren, rolling wasteland called *moors.* The Hebrides have a windy, humid climate.

About 15,000 people live in the Inner Hebrides and 31,000 in the Outer Hebrides. Many of the people rent small farms called *crofts* and grow such crops as barley, oats, and potatoes. Other economic activities include fishing, tourism, weaving, and the distilling of Scotch whisky. Harris Tweed, a famous brand of wool cloth, is made exclusively in the Outer Hebrides.

Norway ruled the Hebrides from the late 800's until 1266, when Scotland took control. Many songs and legends have been written about the islands. H. R. Jones



The Hebrides Islands are part of Scotland. They lie off the west coast of the Scottish mainland. The islands are divided into two groups—the Outer Hebrides and the Inner Hebrides.

WORLD BOOK maps

Hebron, *HEE bruhn* (pop. 50,000), is a city in the West Bank, a region between Israel and Jordan (see **Jordan** [map]). Israel occupies parts of the West Bank, including Hebron.

Hebron is a West Bank marketing and administrative center. Its industries include tanning, food processing, and marble and stone quarrying; and the manufacture of clothes, glass, and shoes. Hebron University, an Islamic university, is there. Hebron's population consists mainly of Arab Muslims. Next to Hebron, Israelis have built a large settlement called Kiriyat Arba.

Hebron is one of the world's oldest cities. It is mentioned in the Bible's Book of Genesis. The city has religious importance to Jews, Muslims, and Christians. Hebron is the site of the Cave of Machpelah, believed to house the tombs of Abraham and his wife, Sarah. Abraham is the ancestor of both the Arabs and the Jews. Today, both a *mosque* (Islamic house of worship) and a *synagogue* (Jewish house of worship) stand above the cave.

Hebron was part of Palestine until 1950, when it became part of Jordan. Israel gained control of Hebron during the Arab-Israeli War of 1967. In 1997, Israeli troops withdrew from most of Hebron. Peter Gubser

See also **Cities of refuge.**

Hecate, *HEHK uh tee,* was a goddess associated with the underworld and black magic in Greek mythology. She belonged to an early race of gods called *Titans.* According to the ancient Greek poet Hesiod, Zeus led the Olympian gods to victory in battle over the Titans. Hecate was the only Titan allowed to retain her powers.

Hecate was originally a benevolent goddess who brought wealth and success to her worshipers—athletes, farmers, fishermen, soldiers, and statesmen. She also protected women and nursed the young. Hecate figured as well in myths and rituals surrounding the goddess Demeter and her daughter, Persephone. Like Persephone, with whom she is sometimes confused, Hecate is associated with the dead. See **Demeter; Persephone.**

Later stories emphasized Hecate's darker aspects. She was considered a goddess of the night and was associated with the moon. People believed Hecate appeared at night, usually at crossroads, carrying torches and accompanied by hellhounds. Nancy Felson

Hecht, *hehkt,* **Ben** (1894-1964), was an American playwright, novelist, and screenwriter. Hecht wrote in a colorful style that may have been influenced by his years as a newspaperman in Chicago.

Hecht became best known for plays he wrote with Charles MacArthur. Their most famous collaboration, *The Front Page* (1928), is a comic melodrama about hard-boiled newspaper life in Chicago. Hecht and MacArthur also wrote *Twentieth Century* (1932), which is a comedy about movie stars. Hecht's first and best-known novel, *Erik Dorn* (1921), deals with a brilliant, cynical journalist.

Hecht was born in New York City but was raised in Racine, Wisconsin. After graduating from high school, he moved to Chicago and began working as a reporter. After 1933, Hecht spent most of his time as a film screenwriter, director, and producer. He won Academy Awards for his writing for *Underworld* (1929) and *The Scoundrel* (1935). He also wrote scripts for such films as *Nothing Sacred* (1937), *Spellbound* (1945), and *Notorious* (1946). In his later years, Hecht worked to establish the state of Israel. Hecht wrote an autobiography, *A Child of the Century* (1954). Samuel Chase Coale

Heckler, Margaret Mary (1931-), was secretary of health and human services from 1983 to 1985. President Ronald Reagan named her to the position. She had served 16 years in the United States House of Representatives as a Republican from Massachusetts. In 1985, Reagan named her U.S. ambassador to Ireland. She held that post until 1989.

In Congress, Heckler supported women's rights and the adoption of the proposed Equal Rights Amendment to the U.S. Constitution. In 1977, Heckler and Representative Elizabeth Holtzman, a Democrat from New York, founded a group that became known as the Congressional Caucus for Women's Issues.

As secretary of health and human services, Heckler introduced a system of set rates for Medicare payments to hospitals. She also helped win Congress's approval of a law that helps ensure payment of court-ordered child support.

Margaret Mary O'Shaughnessy was born in the Flushing section of New York City. She was married to John M. Heckler from 1953 to 1985. Lee Thornton

Hectare. See **Metric system** (Non-SI metric units).

Hector, in Greek mythology, was the greatest hero of the ancient city of Troy. Hector played an important part in the Trojan War, in which Greece defeated Troy. The famous epic poem the *Iliad* tells of important events that occurred during the last year of the war.

Hector was the son of Priam, the king of Troy, and Hecuba. According to some myths, the Greek god Apollo was Hector's father. The *Iliad* described Hector as brave, handsome, and patriotic. He also was a good leader and a loving husband.

During the Trojan War, Achilles, the greatest Greek warrior, refused to fight after quarreling with the Greek commander Agamemnon. As a result, Hector's soldiers drove the Greeks from the walls of Troy back to their ships. Achilles's friend Patroclus wore Achilles's armor in battle and fought in his place. Hector, aided by Apollo, killed Patroclus during the battle.

Achilles returned to the battlefield to seek revenge for the death of Patroclus. Hector's sense of honor made him fight Achilles, even though he knew he would die. Achilles killed Hector and tied the corpse behind his chariot. He dragged Hector's body around the walls of Troy for several days. King Priam begged Achilles for his son's corpse. Achilles pitied Priam and gave him Hector's body so that it could be buried properly.

Cynthia W. Shelmerdine

See also **Iliad; Priam; Trojan War.**

Hecuba, *HEHK yu buh,* was the second wife of Priam, the king of Troy, in Greek mythology. Hecuba and Priam had many children, including the Trojan heroes Hector and Paris. The deaths of her husband and several of their children during the Trojan War caused Hecuba great suffering. When the city of Troy fell to the Greeks, Hecuba was awarded to the Greek leader Odysseus (Ulysses in Latin) as a slave. See also **Paris** (mythology); **Cassandra.** John Hamilton

Hedge apple. See **Osage orange.**

Hedgehog, *HEHJ hahg* or *HEHJ hawg,* is a small animal that looks somewhat like a porcupine. The *common hedgehog* lives in northern Europe and Asia, Asia Minor, southern and eastern Africa, and New Zealand. It is about 9 inches (23 centimeters) long. It has short ears and legs, a short tail, and a long nose. Stiff, needlelike growths called *spines* cover its back and protect the animal from its enemies. When it is in danger, the hedgehog rolls itself into a spiny ball.

Hedgehogs hunt for food at night. They eat insects, snakes, small mammals, birds, and birds' eggs. When cold weather comes, hedgehogs settle down to hibernate. Hedgehogs are easily tamed. Some people keep

© Giuseppe Mazza

The hedgehog has short, sharp spines on its back.

them as pets to get rid of insects and other house pests.

Bruce A. Brewer

Scientific classification. Hedgehogs belong to the hedgehog family, Erinaceidae. The scientific name for the common hedgehog is *Erinaceus europaeus.*

Hedonism, *HEE duh nihz uhm,* is the belief that pleasure is the highest good of life. The term *hedonism* comes from a Greek word meaning *pleasure.* In ancient Greece, the Epicureans and Cyrenaics based their ethical philosophies on the idea that pleasure is the highest good. But the Epicureans believed that people should seek pleasures of the mind rather than pleasures of the body. The wise person, they thought, avoids pleasures that may later cause pain. In modern philosophy, hedonism has taken a different form. The hedonistic utilitarians believe that people should seek not their own individual pleasure alone, but the greatest good for the greatest number of people. They think of good in terms of pleasure (see Utilitarianism). S. Marc Cohen

Heel fly. See Warble fly; Bot fly.

Hegel, *HAY guhl,* **G. W. F.** (1770-1831), was one of the most influential German philosophers. Hegel argued that in order to understand any aspect of human culture, we must retrace and understand its history.

Hegel's emphasis on the importance of historical understanding has greatly promoted the development of the historical study of philosophy, art, religion, science, and politics. The historical approach to human culture inspired by Hegel eventually spread far beyond the borders of Germany.

Hegel's dialectic. Hegel developed a theory of history that became known as his *dialectic.* Hegel believed that all historical developments have three basic characteristics. First, they follow a course that is necessary—that is, they could not have happened in any other way. To understand a historical development in any area of human thought or activity, we must see why it necessarily happened as it did. Second, each historical development represents not only change but progress. Third, Hegel argued that one phase of any historical development tends to be confronted and replaced by its opposite. This opposite, in turn, tends to be replaced by a phase that is somehow a resolution of the two opposed phases. These three phases of a typical dialectical development have often been called *thesis, antithesis,* and *synthesis.* But Hegel did not use those terms.

Hegel applied his dialectic to all areas of human life. For example, he argued that the attempt to achieve satisfaction through the *external* pursuit of power and property tends to be rejected in favor of the attempt to achieve an *inner* state of harmony and tranquility. This opposition between external activity and an inner nonactive state of mind can be resolved by having one's external activity emerge from a harmonious inner state.

Hegel also argued, in a political example, that a period marked by the concentration of political power in one person tends to be followed by a period of widely distributed power. This opposition might be resolved by a period in which there is both some distribution and some concentration of power. Thus, an absolute monarchy might be replaced by an absolute democracy and, in turn, by a representative form of government.

Hegel's writings. In most of his writings, Hegel tried to demonstrate the presence of dialectical developments. In his first published book, *Phenomenology of Spirit* (1807), he dealt with the development of "forms of consciousness." These forms of consciousness include a rich and bewildering variety of states of mind, views of the world, ethical positions, religious outlooks, types of physical activity, and forms of social organization. Hegel tried to demonstrate how they progressed in what he claimed was a necessary and historical sequence that moved through contradiction and resolution to ever greater levels of maturity.

In his second book, *Science of Logic* (1812–1816), Hegel tried to show the same sort of dialectic in the development of philosophical theories about reality. His *Encyclopedia of the Philosophical Sciences* (1817) contains his philosophic system in a condensed form. It has three sections: a shorter version of his book on logic, a "Philosophy of Nature," and a "Philosophy of Spirit." His last book, *Philosophy of Right* (1821), analyzes the dialectical development of social, ethical, and legal systems. After Hegel's death, his students published his lectures on the philosophy of history, religion, and art and on the history of philosophy. They reconstructed the lectures mainly from their notes.

Life. Georg Wilhelm Friedrich Hegel was born in Stuttgart. He attended the University of Tübingen, near Stuttgart. His university teaching career began in 1801 in Jena. He was professor of philosophy at the University of Berlin from 1818 until his death. Ivan Soll

See also Marx, Karl (Marx's ideas).

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Hegira. See Muhammad (The Hijra).

Heidegger, *HY dehg uhr,* **Martin** (1889-1976), was a German philosopher. His ideas have exerted a wide influence on philosophy, the theory of literature and art, and psychiatry.

Heidegger's central philosophical question is "What is Being?" He was not asking the usual questions about the physical makeup of things that exist, or about what properties they possess. Instead, he wanted to understand their very *is-ness* or *being*—what it is for anything to exist rather than not to exist. Heidegger claimed that

this is a difficult but important question that other philosophers had ignored.

Heidegger approached his investigation of the general nature of all being through the study of *human being.* The *being* of humans is, he argued, essentially a "being there," or "being-in-the-world." We are situated in a world with which we have to cope, a world of which we have some sort of awareness, and which we can question. We do not choose to enter this world, but find ourselves "thrown" into it.

Heidegger argued that philosophers have traditionally misunderstood the relation of human beings to the world in which they find themselves. Philosophers tend to focus primarily upon our attempts to know this world. However, we do not deal with the world exclusively or even primarily by trying to know it. We instead interact with the world in complex ways that require action and "concern" more than knowledge.

Heidegger was preoccupied with the nature of human existence. He emphasized its more dreary aspects, such as alienation, death, and anxiety. He insisted upon the difficult task of living authentically and with commitment. Because of these concerns, he has often been considered an existentialist (see **Existentialism**). These investigations culminated in Heidegger's major work, *Being and Time* (1927).

In the 1930's, Heidegger turned even more radically away from what he thought was the mistaken direction of most traditional philosophy. He came to believe that a better understanding of being had been reached by certain poets, especially Friedrich Hölderlin. He also included a few philosophers on the margins of the tradition, such as Friedrich Nietzsche and the pre-Socratic philosophers of ancient Greece. In interpreting the texts of these figures, he claimed to uncover deep and original meanings of which even the authors themselves may have been unaware. His interpretations often involve wordplays and *etymologies* (the histories of words).

Heidegger was born near the university town of Freiburg, Germany. There he later studied, taught, and became rector of the university. His public support of the Nazis has made him controversial. Ivan Soll

Heidelberg, *HYD uhl burg* (pop. 136,796), is a city in southern Germany. For location, see **Germany** (political map). Heidelberg lies in a scenic setting along the Neckar River. The ruins of beautiful Heidelberg Castle, begun in the Middle Ages but built mostly in the 1500's and 1600's, stand high on a steep bank of the river and overlook the city. Concerts and an annual summer drama festival are held at the castle. The picturesque old section of the city is the home of the University of Heidelberg. The university, which was founded in 1386, is Germany's oldest university and still one of its most outstanding seats of learning.

Heidelberg's quaint features have inspired romantic works about the city. Sigmund Romberg's operetta *The Student Prince* is perhaps the most famous of these works. Many tourists visit Heidelberg and contribute greatly to the economy. Important products include cement, precision instruments, and printing machinery.

Heidelberg was developed in the Middle Ages. In the late 1600's, French armies destroyed most of the city and left the castle in ruins. Peter H. Merkl

See also **Germany** (picture: Picturesque Heidelberg).

Heidelberg, University of, is the oldest university in Germany. It was established in Heidelberg in 1386. The university has divisions of biology, classical and Oriental studies, economics, history, law, mathematics, modern philology, medicine, natural sciences, philosophy, social sciences, and theology. Its library, founded in the 1500's, consists of more than a million books, including a collection of old German manuscripts. Many of the university's 27,500 students come from countries other than Germany.

The University of Heidelberg, which was modeled after the University of Paris, originally had four departments—arts, law, medicine, and theology. During the 1500's, it became the center of Protestant learning. The University of Heidelberg was reorganized in 1803 and became a center for the study of German folklore and medieval literature. It is supported by the German state of Baden-Württemberg. P. A. McGinley

Heidelberg jaw, *HYD uhl burg,* is a fossil bone from a prehistoric human being who probably lived between 300,000 and 400,000 years ago. But some scientists believe the jaw might be 500,000 to 700,000 years old. The fossil is a jawbone with most of its teeth still intact. The jaw is larger than that of a modern human being and lacks a chin. Workers digging in a sandpit found it in 1907 in the village of Mauer, Germany, near Heidelberg.

The jaw received much attention when it was discovered because by that time scientists had found only a few other fossils of prehistoric human beings. However, more recent fossil discoveries in Europe, Asia, and Africa have decreased the importance of the jaw and changed scientists' understanding of it. Many of the later finds are more complete skeletons. Originally, experts believed the Heidelberg people belonged to a kind of prehistoric human being known as *Homo erectus.* Scientists now believe the Heidelberg jaw should be classified as an early form of the modern human species, *Homo sapiens.* Alan E. Mann

Heifetz, *HY fehts,* **Jascha,** *YAH shuh* (1901-1987), was a Lithuanian-born violinist. From the time of his 1917 Carnegie Hall debut in New York City, his playing became the standard by which other violinists were measured. He recorded virtually all the great pieces written for violin and made many popular arrangements. He often was the first person to play the works of contemporary composers.

Heifetz was born in Vilnius, in Lithuania. When he was 3 years of age, his father began to teach him to play the violin. At 5, Heifetz entered the Imperial School of Music in Vilna. He later studied with the famous teacher, Leopold Auer, in Saint Petersburg, Russia. Heifetz began to play in public when he was 6. At 13, he made his debut in Berlin and won international fame. During the Russian Revolution, Heifetz escaped to the United States. He became an American citizen in 1925. Stephen Clapp

Height and weight tables. See **Adolescent; Baby; Child; Growth.**

Heimlich maneuver. See **First aid** (Choking).

Heine, *HY nuh,* **Heinrich,** *HYN rihkh* (1797-1856), ranks among the most popular writers in German literature. Several of Heine's poems are so well known they are considered part of German folklore. Heine's poetry has been set to music by such composers as Schubert, Mendelssohn, and Brahms.

Heine was born in Düsseldorf. Much of his early poetry was collected in the *Book of Songs* (1827). This collection of love poetry is Heine's best-known work and the most famous book of poetry in German literature. The poems are described as "bittersweet" because they combine simplicity and beauty with an irony that gives them a cynical tone. The most famous is "The Lorelei."

Heine's early prose is a unique combination of fiction and essay that was often imitated. Much of it was published in four volumes of *Travel Pictures* (1826-1831). Like most of Heine's writings, these are characterized by wit, irony, clarity, and intelligence.

Heine was one of the "Young Germans," a group of writers who were political radicals (see **German literature** [The young Germans]). He was attracted to the atmosphere of liberalism in France and moved to Paris in 1831. He lived there for the rest of his life. In Paris, Heine tried to bring about understanding between France and Germany, traditional enemies. He wrote a series of essays and newspaper articles to explain to the Germans the newly organized French constitutional monarchy. He described German culture to the French in *The Romantic School* (1833), *On the History of Religion and Philosophy in Germany* (1835), and other books.

Heine grew increasingly bitter about the lack of freedom in Germany, and his books were banned in that country in 1835. Heine satirized the German political situation in two long mock-epic poems, *Germany: Winter's Tale* (1844) and *Atta Troll, A Midsummer Night's Dream* (1847).

Heine became paralyzed in 1848 and was confined to a "mattress-grave," as he called his bed, for the rest of his life. But his sufferings did not destroy his wit, intelligence, or literary talent. He continued to write on cultural, political, and religious topics. He also produced two collections of poetry—*Romancero* (1851) and *Poems 1853-1854.* Jeffrey L. Sammons

Heinlein, *HYN lyn,* **Robert A.** (1907-1988), was a popular and influential American author of science fiction. He wrote for both children and adults.

Heinlein's most popular novel, *Stranger in a Strange Land* (1961), explores controversial ideas about morality, religion, and sex. *The Past Through Tomorrow* (1967) contains a series of stories and short novels written from 1939 to 1962. Together, they describe a "future history" of the human race. Some of the characters from the future history series reappear in such Heinlein novels as *Time Enough for Love* (1973), *Friday* (1982), and *The Cat Who Walks Through Walls* (1985).

Heinlein wrote several science-fiction novels for young people between 1947 and 1963. These books anticipate many themes of his adult work. The best of these novels include *Rocket Ship Galileo* (1947) and *Starman Jones* (1953).

Robert Anson Heinlein was born in Butler, Missouri. He graduated from the United States Naval Academy in 1929. Heinlein served as a naval officer for five years and then worked in other fields before becoming a writer.

Neil Barron

Heir, *air.* Technically, an heir is a person who receives money or property that is left by someone who died *intestate* (without making a will). *Legatee* or *devisee* is the legal term for the beneficiary of a will. However, the word *heir* is commonly used for anyone awarded an estate, whether or not the deceased person left a will.

The word *heir* comes from a Latin term that means *one entitled to inherit.* Normally, heirs are the spouse and children or grandchildren of the deceased person. If there are no surviving descendants or spouse, then parents, grandparents, brothers, sisters, or other relatives inherit. State laws vary as to who inherits and in what proportions. If there are no surviving heirs, the property goes to the state. This condition is called *escheat.* William M. McGovern

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Heisenberg, *HY zuhn BURG,* **Werner,** *VEHR nuhr* (1901-1976), a German physicist, is best known for his contributions to atomic theory. Heisenberg developed the *uncertainty principle,* which states that both the position and the momentum of a subatomic particle cannot be accurately determined simultaneously. Heisenberg discovered the uncertainty principle in 1927. He won the 1932 Nobel Prize in physics for founding one version of the field of physics called *quantum mechanics* (see **Quantum mechanics**).

Heisenberg based his theories about atomic structure on the frequencies of light given off by atoms. In 1913, the Danish physicist Niels Bohr had suggested that electrons in an atom could travel only in a certain set of orbits around the nucleus. Bohr had also shown that atoms radiate light due to changes in the arrangement of their electrons. During the early 1920's, Heisenberg used studies of atomic spectra to develop *matrix mechanics,* a form of quantum mechanics that provides a mathematical description of electron orbits.

Heisenberg was born in Würzburg, Germany. He studied at the University of Munich. Richard L. Hilt

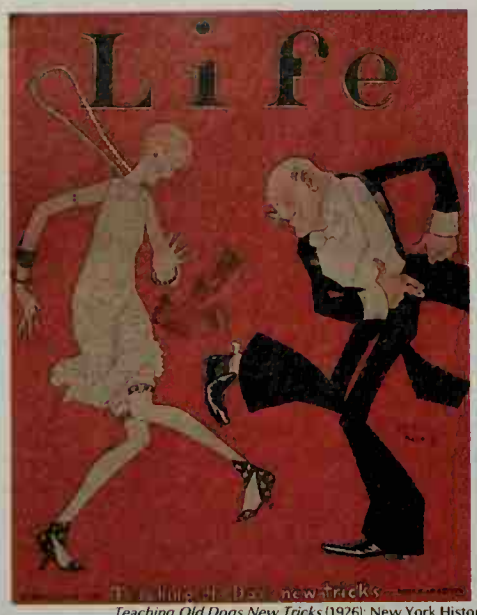
Heisman Memorial Trophy is awarded annually to the outstanding college football player in the United States. A group of sportswriters and sportscasters selects the winner of the trophy. The Heisman trophy is sponsored by the Downtown Athletic Club of New York City.

The trophy was first awarded in 1935. The next year it was named for John W. Heisman, a leading football coach at a number of colleges from 1892 to 1927. A table of Heisman trophy winners appears in the *World Book* article on **Football.** William F. Reed

Hekla, *HEHK luh,* is a famous volcanic mountain in southwestern Iceland. The mountain is located about 30 miles (48 kilometers) from the coast and rises 4,892 feet (1,491 meters) above sea level. The main crater had been quiet for more than 100 years when the volcano erupted on March 29, 1947. That eruption lasted 13 months. Lava spread over an area of 15 square miles (39 square kilometers), and ash fell as far away as Finland. Smaller eruptions took place in 1980, 1981, and 1991.

George W. Rich

Held, John, Jr. (1889-1958), was an American cartoonist. He was best known for his delightful pictures of the manners and pastimes of the period in America known as the Roaring Twenties. Held's drawing style was elegant and sophisticated, like the fashionable, fun-loving people he portrayed. His humor was sympathetic rather than harsh, and he dealt with his subjects affectionately.



Teaching Old Dogs New Tricks (1926); New York Historical Society

A magazine cover by John Held, Jr., portrays a stylish but frivolous woman of the 1920's called a *flapper.* Held became famous for his pictures of the period called the Roaring Twenties.

Held popularized the image of the stylish but frivolous young women of the 1920's called *flappers.* See **Roaring Twenties** (picture).

John Held, Jr., was born in Salt Lake City, Utah, and moved to New York City in 1910. He drew cartoons and covers for *Harper's Bazaar, Vanity Fair, Life, The New Yorker,* and other magazines. By the late 1920's, his cartoons were being distributed to newspapers across the United States. Elizabeth Broun

Heldentenor. See Opera (The singers).

Helen of Troy, in Greek mythology, was the most beautiful woman in the world. She was the major cause of the Trojan War, in which Greece defeated the city of Troy.

Helen was the daughter of Zeus, the king of the gods, and Leda, a human being. According to one myth, Zeus appeared in the form of a swan when he visited Leda. Helen later hatched from a swan's egg. Another myth tells that Zeus mated with Nemesis, the goddess of fate, who gave Leda the egg from which Helen was born.

When Helen was a child, an Athenian hero named Theseus fell in love with her and kidnapped her. Helen's brothers, Castor and Pollux, rescued her. Many Greek heroes courted Helen, but she married Menelaus, the king of Sparta.

A Trojan prince named Paris visited Sparta and persuaded Helen to return to Troy with him. Menelaus's brother, Agamemnon, led a Greek army against Troy to win Helen back. Paris was killed during the war. Helen then married Paris's brother, Deiphobus, who was also killed. After the Greeks captured Troy, Helen and Menelaus were happily reunited.

According to a legend told by the poet Stesichorus, Helen never reached Troy with Paris. She and Paris got as far as Egypt, where she remained as the guest of King Proteus. A phantom of Helen went to Troy in her place. After the war, Menelaus and Helen were reunited in Egypt. Euripides, a Greek playwright of the 400's B.C., used this version of the myth in his play *Helen.*

Helen's personality has long fascinated writers. Some authors have portrayed her as a deceitful woman driven by passion to betray her country and family. But other writers have regarded Helen as an innocent victim of her own beauty. Cynthia W. Shelmerdine

See also **Menelaus; Trojan War.**

Helena, *HEHL uh nuh* (pop. 25,780), is the capital of Montana. It serves as the trading and supply center for a mining and agricultural region. Helena lies in west-central Montana, about 95 miles (153 kilometers) southwest of Great Falls. For location, see **Montana** (political map).

The town of East Helena, 3 miles (5 kilometers) east of Helena, is a center for refining lead and zinc ores. Products of Helena include beverages, bricks and tiles, foods, paints, and steel products. Many federal agencies have offices in Helena. The city is the home of Carroll College and the Montana Historical Society. The Capitol is topped by a statue representing Liberty.

Helena sprang up after 1864, when gold was discovered in Last Chance Gulch. The gulch is now the main street of Helena. The territorial capital moved from Virginia City to Helena in 1875. According to one theory, Helena was named for Helena, Minnesota, by a former resident of the Minnesota community. In 1935, Helena was shaken by a series of earthquakes which began on October 12. A total of 1,200 shocks were recorded in an 80-day period. A severe series of shocks on October 18 caused two deaths and resulted in $3\frac{1}{2}$ million worth of damage to property in the city.

Helena is the seat of Lewis and Clark County. It has a commission form of government. Bill Skidmore

See also **Montana** (picture: The State Capitol).

Helgoland is an island in the North Sea. It belongs to Germany and covers about $\frac{3}{4}$ square mile (2 square kilometers). It has a population of about 2,200. The United Kingdom ceded Helgoland to Germany in 1890 in exchange for Zanzibar in Africa. Before World War I, it was a summer resort and the home of people who fished for a living. At the beginning of the war, in 1914, the people were taken to the German mainland, and the island became a naval base. The peace treaty in 1919 ordered Helgoland's fortifications and sea wall torn down. It later became apparent that, unless the sea walls were restored, the entire island might disappear, for one third of it had already washed away. After Adolf Hitler's rise to power, the walls were rebuilt, and Helgoland became strategically important in World War II. In 1947, the island's population was removed, and the British Navy set off 3,500 tons (3,180 metric tons) of high explosives. All the German submarine pens, underground fortifications, and all other military installations were destroyed. In 1952, Helgoland was returned to West Germany (now part of Germany). The Germans resettled the island and built it into a resort area. Frank Ahnert

WORLD BOOK map

Location of Helgoland

Boeing Company

A heavily armed attack helicopter on a mission

Doug Wilson, Black Star

A helicopter hovering over a logging site

AP/Wide World

A transport helicopter serving as a flying ambulance

Sheldon Cohen, Bell Helicopter Textron Inc.

A business helicopter landing on a downtown rooftop

The tasks of helicopters include jobs that airplanes cannot do. Unlike planes, military *attack helicopters* can turn instantly to fire weapons in almost any direction. Helicopters can hover in midair. They can also take off from and land in small areas, such as rooftops or places where a person is injured.

Helicopter

Helicopter is an aircraft that is lifted into the air and kept aloft by one or two powerful whirling rotors. A helicopter rotor resembles a huge propeller that is parallel to the ground. However, the rotor is actually a rotating wing. The name *helicopter* refers to the rotor. It comes from Greek words meaning *spiral* and *wing*. Nicknames for the helicopter include "chopper" and "whirlybird."

A helicopter can fly straight up or straight down, forward, backward, or sideways. It can even *hover* (stay in one spot in the air). Unlike most airplanes, helicopters can take off and land in a small space. In addition, they can fly safely at much slower speeds and lower altitudes than airplanes. However, they cannot fly as fast as most planes. Most helicopters cannot exceed 200 miles (320 kilometers) per hour. At faster flight speeds, the velocity of the rotor blade tips approaches the speed of sound, and it becomes difficult to rotate the rotor. At high speeds, strong vibrations also develop that could damage the blades. Helicopters also use more fuel than airplanes to travel the same distance. In general, helicopters can fly only two to three hours—or less than 600 miles (970 kilometers)—without refueling.

Helicopters range in size from tiny, single-seat models to huge transports that can carry two trucks in their cargo hold. The heaviest helicopter ever manufactured is the Mil Mi-26, built in Russia. It weighs 31 tons (28 metric tons) and can carry 22 tons (20 metric tons) of cargo.

William A. Crossley, the contributor of this article, is Associate Professor in the School of Aeronautics and Astronautics at Purdue University.

Uses of helicopters

Because of helicopters' ability to hover in midair and to take off and land in small areas, they can be used for many tasks. They are particularly useful (1) for rescue missions, (2) for aerial observation, (3) for transportation and construction work, (4) for agricultural and forestry operations, and (5) for military missions.

For rescue missions. Helicopters have rescued many people. A helicopter can hover above a disaster scene and lower a sling or harness to endangered people below. The rescuers can then pull the people up and fly them to safety. Helicopters have plucked people from burning skyscrapers, sinking ships, and rising floodwaters. They have flown injured skiers and stranded mountain climbers to safety. Serving as flying ambulances, helicopters can land near automobile or airplane crashes and rush the injured to hospitals. Helicopters can also deliver food and medicine to areas that other vehicles cannot reach because of earthquakes, floods, or storms.

For aerial observation. In many cities, the police use helicopters to trail fleeing suspects and direct squad cars on the ground. Law enforcement agents in helicopters look for lost people and escaped convicts. Law enforcement agents also patrol national borders on the lookout for smugglers and illegal immigrants.

Many radio and television stations use helicopters to cover news events. In large cities, helicopter pilots ob-

serve traffic and broadcast radio reports warning drivers of traffic jams. Motion-picture companies often film from helicopters to give audiences a bird's-eye view of a scene. Helicopter pilots fly low along pipelines, railroad tracks, and power lines to look for damage.

Helicopters are used to explore wilderness areas, to survey land, and to help locate oil and other resources. From helicopters, scientists count wildlife populations and chart the migration routes of wild animals. Some fishing fleets use helicopters to spot schools of fish.

For transportation and construction work. Helicopter transportation is expensive. However, the convenience of helicopter flight makes "choppers" ideal transport vehicles for certain uses. The flexibility, security, and speed of helicopter travel have made it a major method of transportation for political leaders in many countries. Helicopter travel saves business executives time. From *heliports* (airports for helicopters) atop downtown office buildings, executives may fly directly to nearby cities for meetings.

Helicopter service is essential to many offshore oil-drilling operations. Numerous offshore wells are in rough ocean waters that make it hazardous to bring in replacement crews and supplies by ship. However, helicopters can land on the drilling platforms and so provide much faster and safer delivery than ships.

Helicopters are often used to transport cargo that is too large or awkward for other vehicles to haul. The cargo is carried in a sling hanging below the craft.

Powerful helicopters are used in construction work as "flying cranes." Workers in helicopters install antennas and huge air conditioners atop tall buildings and erect preassembled electric power transmission towers. Workers also use helicopters to pour concrete in hard-to-reach places and to put bridge sections in position.

For agricultural and forestry operations. Farmers use helicopters to spread seeds, fertilizers, weedkillers, and insecticides over large areas. The downdraft caused by the rotors can aid in these applications. Instead of building roads, some companies that manufacture forest products depend on helicopters to transport logging crews into and out of forests and to carry out logs.

For military missions. In the armed forces, helicopters serve as flying ambulances and as troop transports.

U.S. Coast Guard

Helicopter rescue missions have saved the lives of thousands of people. The United States Coast Guard helicopter shown here has picked up the crew members from a sinking ship.

Military helicopters carry artillery to key battle positions and transport jeeps, tanks, and other equipment. Helicopters equipped with electronic gear pick up and disrupt enemy communications signals. The armed forces also use helicopters to observe the movements of enemy troops and ships. Many naval helicopters have devices to locate and track submarines. They may also be armed with depth charges, missiles, or torpedoes. Army *attack helicopters,* also called *gunships,* may carry cannons, machine guns, rockets, or missiles. Their main targets are enemy ground vehicles, particularly tanks.

Types of helicopters

Single-rotor helicopters are the most common type of helicopters. A single-rotor helicopter has one main rotor mounted above its body. Although such an aircraft is called a single-rotor helicopter, it also has a second, smaller rotor mounted on its tail. The main rotor may have from 2 to 8 blades. It provides the helicopter with both lift and propulsion. The tail rotor has from 2 to 13 blades. It is usually mounted vertically on either side of the tail at a right angle to the main rotor. The tail rotor overcomes the tendency of a helicopter to spin in a direction opposite to that of the main rotor and helps to

Fred Ward, Black Star

Crop-dusting by helicopter enables farmers to spray agricultural chemicals exactly where they are needed. This specially equipped helicopter is spraying a field with insecticide.

Sikorsky Aircraft

An antisubmarine helicopter, armed with torpedoes, takes off from the deck of a U.S. Navy ship. Such helicopters carry electronic devices to locate and track submarines.

control direction. Some helicopters have the tail rotor mounted inside a duct that goes though the tail. Such a system is called a *fenestron* or *fan-in-fin*. On some single-rotor helicopters, a system that uses jets of pressurized air, rather than a tail rotor, helps control the craft.

Twin-rotor helicopters have two main rotors. The rotors turn in opposite directions and so eliminate the need for a tail rotor. Two basic types of twin-rotor helicopters are widely used: *tandem-rotor helicopters* and *coaxial-rotor helicopters*. A tandem-rotor helicopter has a main rotor mounted above each end of its body. A coaxial-rotor helicopter has one rotor above the other. The rotors are mounted above the middle of the helicopter's body. The shaft of the upper rotor turns inside the shaft of the lower rotor.

How helicopters fly

Lift is the force that causes an aircraft to overcome gravity, climb into the air, and stay aloft. Most aircraft rely on wings to produce lift. An airplane has *fixed* (immovable) wings that create lift as the airplane moves forward. Helicopter rotor blades are *rotary wings*. An engine turns the rotor, and the blades generate lift as they whirl through the air.

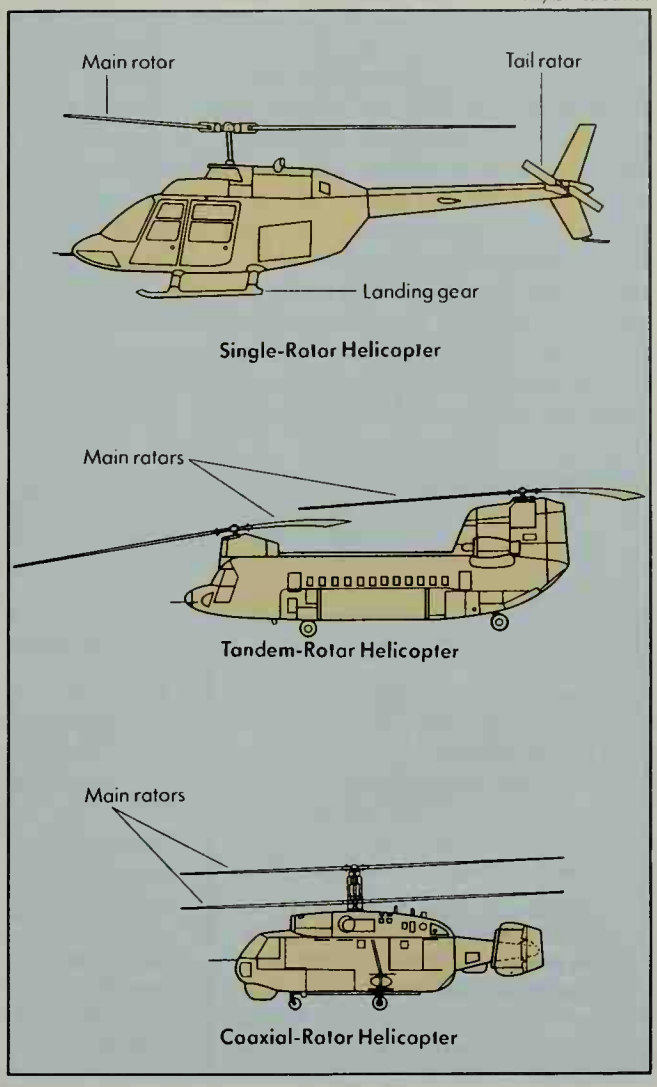
The special shape of wings helps them create lift. A wing's upper surface is curved, and its lower surface is less curved or flat. As a wing moves or whirls through the air, air flows over and under the wing. In the same amount of time, the air flowing over the curved upper surface travels farther than the air flowing under the wing. The air thus flows faster over the wing than under it. This difference in air speed creates a difference in air pressure above and below the wing. There is less pressure on the upper surface than on the lower surface. Because air pushes more strongly against the bottom of the wing than against the top, lift is created. See **Aerodynamics** (Principles of aerodynamics).

Helicopter pilots, like airplane pilots, can control the amount of lift by changing the angle that the wings make with the airflow. This angle is called the *angle of attack*. You can demonstrate the relation between lift and the angle of attack by using a kite to serve as a simple wing. Hold the kite flat and point it into the wind. If you then slightly raise the front of the kite, you increase the angle of attack. You will feel a force trying to push the kite upward. This force is the lift created by the wind as it pushes against the bottom surface. If you decrease the angle of attack, the force becomes weaker.

Piloting a helicopter. The pilot of a single-rotor helicopter operates three basic controls inside the cockpit. (1) The *collective pitch lever* makes the helicopter climb, hover, or descend. (2) The *control column*, also called the *cyclic pitch control*, causes the aircraft to fly forward,

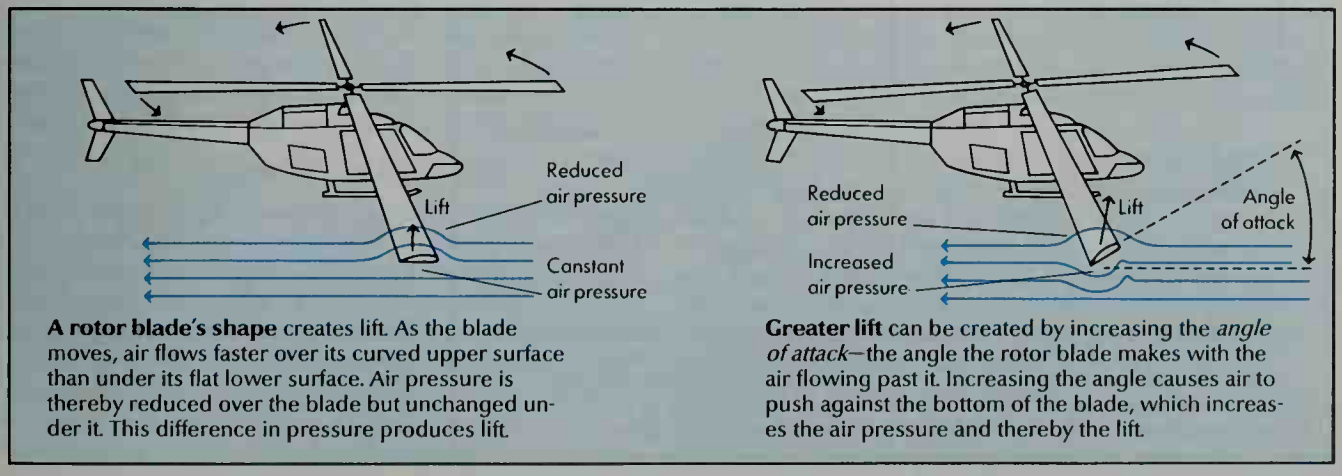
Types of helicopters

WORLD BOOK illustrations by Zorica Dabich



How a helicopter rotor produces lift

WORLD BOOK illustrations by Zorica Dabich

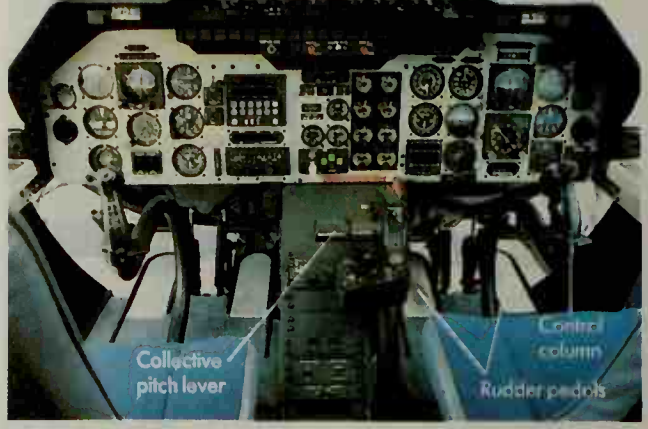


A rotor blade's shape creates lift. As the blade moves, air flows faster over its curved upper surface than under its flat lower surface. Air pressure is thereby reduced over the blade but unchanged under it. This difference in pressure produces lift.

Greater lift can be created by increasing the *angle of attack*—the angle the rotor blade makes with the air flowing past it. Increasing the angle causes air to push against the bottom of the blade, which increases the air pressure and thereby the lift.

backward, or sideways. (3) The *rudder pedals* swing the tail around so that the helicopter can turn. Each control varies the *pitch* (angle) of the main rotor or tail rotor blades. A system of cables, rods, and other devices leads from the cockpit controls to the rotor blades.

Climbing, hovering, and descending. The pilot's left hand moves the collective pitch lever up and down. By raising the lever, the pilot increases the pitch of all main rotor blades equally. The increased pitch, in turn, increases the lift generated by the spinning rotor. When lift exceeds the force of gravity, the helicopter goes straight up. After reaching a particular altitude, the pilot may want to hover. The pilot then lowers the lever to decrease the pitch of the rotor blades and so reduce the amount of lift. When the rotor's lifting force has been reduced just enough to counteract the pull of gravity, the



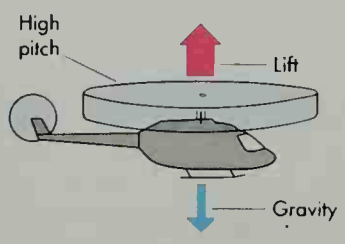
Bell Helicopter Textron

Helicopter controls. Moving the *collective pitch lever* makes the helicopter climb, hover, or descend. Tilting the *control column* causes forward, backward, or sideways flight. Pushing the *rudder pedals* controls the direction the helicopter points. This photo shows a craft with dual controls for the pilot and copilot.

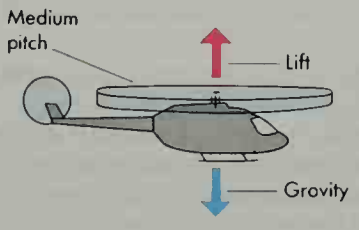
Piloting a helicopter

A pilot flies a helicopter by varying the *pitch* (angle) of the rotor blades. The lift of the main rotor counteracts gravity. The force of the tail rotor counteracts *torque*, a force that tends to spin the aircraft in the direction opposite that of the main rotor. In these diagrams, the pitch of the blades is indicated by the thickness of the circles showing the area swept by the rotor.

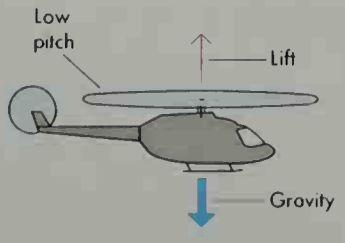
WORLD BOOK illustrations by Zorica Dabich



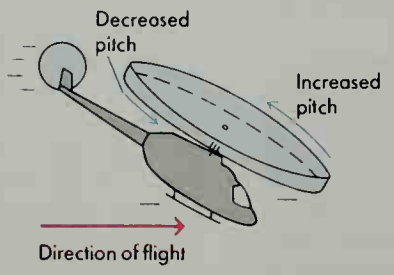
Climbing. Raising the collective pitch lever increases the pitch of the main rotor blades. Lift is increased, and the craft climbs.



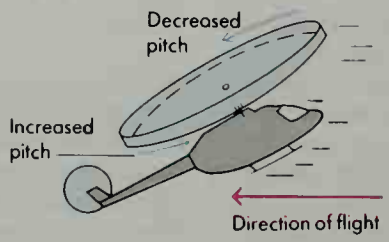
Hovering. Holding the collective pitch lever so the blades have medium pitch produces just enough lift to counteract gravity. The craft then hovers.



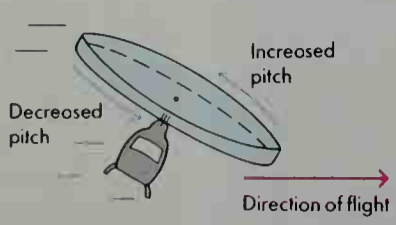
Descending. Lowering the collective pitch lever decreases the pitch. The blades create little lift, and gravity causes the helicopter to descend.



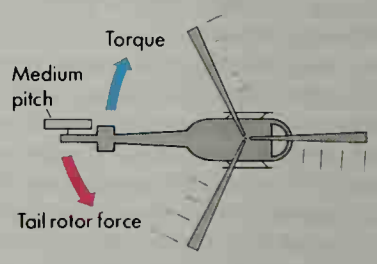
Forward flight. Tilting the control column forward makes the pitch greatest as the blades approach the tail. The rotor tilts up in the rear, and the craft flies forward.



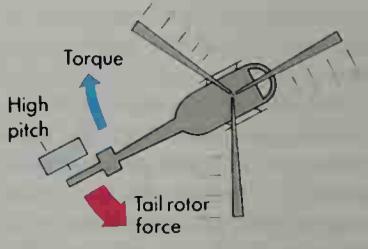
Backward flight. Tilting the column back makes the pitch greatest as the blades approach the nose. The rotor tilts up in front, and the craft flies backward.



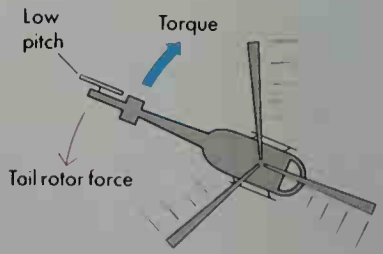
Sideways flight. Tilting the column to one side makes the rotor tilt up on the opposite side. The craft then flies in the direction the column is tilted.



Pointing straight. If neither rudder pedal is pushed, the tail rotor force balances the torque. The helicopter then points straight ahead.



Turning left. Pushing the left rudder pedal increases the pitch, and thus the force, of the tail rotor blades. The tail rotor force turns the craft left.



Turning right. Pushing the right rudder pedal decreases the pitch, and thus the force, of the tail rotor blades. Torque then swings the craft to the right.

craft will maintain a constant altitude. To descend, the pilot lowers the collective pitch lever farther, thereby decreasing the lift. When lift becomes weaker than the force of gravity, the craft descends.

Flying forward, backward, and sideways. The pilot's right hand operates the control column, a stick between the knees. The pilot can tilt the control column in any direction, and the helicopter responds by moving in the same direction. When the control column is tilted, the pitch of the main rotor blades alternately increases and decreases as they sweep through opposite sections of their circular path. To fly forward, the pilot pushes the column ahead. This causes the pitch to be greatest just before the blades pass over the tail. The blades have the least pitch just before they reach the nose. These changes in pitch cause the rotor blades to rise slightly in the rear. The rotor then tries to pull the helicopter both upward and ahead. But gravity counteracts the upward pull, and so the aircraft moves forward in level flight.

To fly backward, the pilot pulls back on the control column. This gives the blades the most pitch as they approach the nose and the least pitch as they approach the tail. The nose rises, the tail dips, and the helicopter flies backward. The aircraft can be made to fly sideways in a similar manner.

Turning. As a helicopter's main rotor spins in one direction, it creates a force that pushes against the body of the craft in the opposite direction. This twisting force is called *torque*. It must be overcome or the helicopter will be out of control and simply turn in circles.

If the main rotor of a single-rotor helicopter spins in a counterclockwise direction, the push of the torque is clockwise. The tail rotor counteracts the torque and enables the pilot to change the helicopter's direction. The pilot controls the tail rotor by stepping on two rudder pedals. If neither pedal is depressed, the tail rotor blades spin at just the right pitch to produce exactly enough sideways force to counteract the torque. The helicopter then points straight ahead. To swing left, the pilot steps on the left rudder pedal, thereby increasing the pitch of the tail rotor blades. The increased force of the rotor pushes the tail in the direction opposite to the clockwise push of the torque. The helicopter then turns to the left. To turn right, the pilot depresses the right rudder pedal and so decreases the pitch—and thus the force—of the tail rotor blades. The torque itself then swings the tail in a clockwise direction, which turns the helicopter to the right.

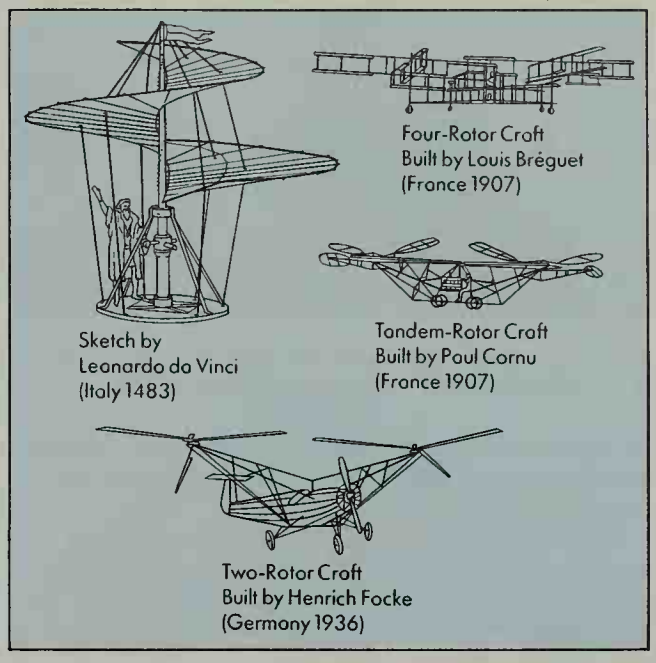
On a twin-rotor helicopter, the main rotors turn in opposite directions. The torque generated by one rotor thus cancels out that generated by the other. To turn the craft, the pilot changes the pitch of the rotors so that the torque of one rotor is greater than that of the other.

Development of the helicopter

Early designs and experiments. The earliest known mention of a rotor-powered flying machine appears in a Chinese text written about A.D. 320. The design of this machine may have been based on a Chinese toy called the *flying top*. Such toys flew by means of feather rotors. In 1483, the great Italian artist and scientist Leonardo da Vinci sketched a design for a helicopter. It had a large, screwlike wing made of starched linen. In 1784, two Frenchmen known only by their last names, Launoy and Bienvenu, built the first model helicopter in Europe that could fly. Based on the Chinese flying top, it had two rotors made of feathers. Throughout the 1800's, inventors in Europe and the United States experimented with model helicopters. The steam engines and electric motors of that time were too weak or too heavy to power a full-sized helicopter.

Early helicopters

WORLD BOOK illustrations by Zorica Dabich



By the early 1900's, small, powerful gasoline engines had been developed that made human helicopter flight possible. The first flight took place in 1907. The craft was a four-rotor helicopter built by Louis Bréguet, a French inventor. The helicopter lifted one of Bréguet's assistants about 2 feet (60 centimeters) into the air for a minute. Assistants on the ground steadied the helicopter during the flight. Later in 1907, a French mechanic named Paul Cornu made the first free flight in a helicopter. He flew his tandem-rotor aircraft to a height of about 6 feet (1.8 meters) for about 20 seconds.

The first practical helicopters. Early helicopters were difficult to control, and their flight was wobbly. In 1935, Bréguet and another Frenchman, René Dorand, built a coaxial-rotor helicopter that was easier to control and flew far more steadily. In 1936, Heinrich Focke, a German inventor, built a twin-rotor helicopter that was even further advanced. The following year, it reached a speed of 76 miles (122 kilometers) per hour and an altitude of about 8,000 feet (2,400 meters). It could stay aloft for 1 hour and 20 minutes.

The first flight of a practical single-rotor helicopter took place in the United States in 1939. The craft was built and flown by Igor I. Sikorsky, a Russian engineer who had moved to the United States in 1919. The British and the U.S. armed forces used an improved version of Sikorsky's helicopter during World War II (1939-1945).

Further improvements. During the mid-1900's, the military use of helicopters began to increase greatly, which led to major improvements in their design. Helicopters had been used mainly for patrol and rescue missions in World War II. New tasks for the helicopter dur-

Sikorsky Aircraft

The first practical single-rotor helicopter was built and flown by Igor Sikorsky. Its first flight, *shown here,* was in 1939.

ing the Korean War (1950-1953) included armed observation of the enemy and the transportation of troops and supplies to hard-to-reach areas.

During the Vietnam War (1957-1975), thousands of armed U.S. attack helicopters, also called *gunships,* flew combat missions. During the 1991 Persian Gulf War, the U.S. military used helicopters that could fire missiles at Iraqi targets, wait to see the results, and then fire again if the target was not destroyed.

The ever-expanding military use of helicopters encouraged the development of faster, larger, and more powerful craft. In the 1940's and 1950's, engineers adapted the jet engine for use in helicopters. Jet engines were lighter and more powerful than the engines previously used to turn the rotor shafts. They enabled helicopters to fly faster and higher and to carry heavier loads. In addition, new construction materials made helicopters lighter, safer, and stronger. For example, metal and wooden blades have been replaced with more durable blades made from composite materials, usually plastic reinforced with carbon fibers.

Recent developments include efforts to increase the speed and range of helicopters and to design and build helicopters that do not need a pilot. A *tiltrotor* aircraft combines features of both helicopters and airplanes. It has a wing like an airplane's and two main rotors, one at each wing tip. The tiltrotor can take off, hover, fly, and land like a helicopter. But by rotating the rotors from a horizontal to a vertical position, the tiltrotor can fly like an airplane. This feature gives the tiltrotor higher speeds and a longer range than a traditional helicopter.

Manufacturers are also developing helicopters for use as *unmanned aerial vehicles* (UAV's). These unpiloted vehicles can fly missions that are too dangerous or too tedious for pilots. William A. Crossley

Related articles in *World Book* include:

Aerodynamics
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Outline

I. Uses of helicopters
- A. For rescue missions
- B. For aerial observation
- C. For transportation and construction work
- D. For agricultural and forestry operations
- E. For military missions

II. Types of helicopters
- A. Single-rotor helicopters
- B. Twin-rotor helicopters

III. How helicopters fly
- A. Lift
- B. Piloting a helicopter

IV. Development of the helicopter

Questions

What kind of wings does a helicopter have?
How are helicopters used in the construction industry?
What is a *tandem-rotor helicopter*? A *coaxial-rotor helicopter*?
Who built and flew the first practical single-rotor helicopter?
What are some military uses of the helicopter?
Why does a single-rotor helicopter have a tail rotor?
What is a *compound helicopter*?
In what ways can a helicopter fly that an airplane cannot?
What happens if a helicopter's collective pitch lever is raised?
Why is helicopter service essential to many offshore oil-drilling operations?

Additional resources

Everett-Heath, John. *Helicopters in Combat.* Arms & Armour, 1993.
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Stille, Darlene R. *Helicopters.* Children's Pr., 1997. Younger readers.

Heliograph, *HEE lee uh graf,* was an instrument used to send signals by reflecting sunlight with a mirror or mirrors. Heliographs were used by the armies of several countries during the late 1800's.

Heliograph equipment varied somewhat from country to country. The heliograph used by the United States Army had a mirror with a sighting rod—or else two mirrors—mounted on a tripod. A screen or shutter for interrupting the flashes was mounted on another tripod. If the sun was in front of the sender, its rays were reflected directly from a mirror to the receiving station. The sender used the sighting rod to line the flash up with the receiver. If the sun was behind the sender, its rays were reflected from one mirror to another, and from the second mirror to the receiver. The flash was lined up with the receiver by adjusting the two mirrors. Messages were sent as short and long flashes by opening and closing the shutter. The flashes represented the dots and dashes of the Morse code.

The distance that heliograph signals could be seen depended on the clearness of the sky, the length of uninterrupted sight, and the size of the mirrors used. Under ordinary conditions, a flash could be seen 30 miles (48 kilometers) with the naked eye and much farther with a telescope. Carol E. Stokes

See also Morse code.

Helios, *HEE lee ahs,* was the sun and god of the sun in Greek mythology. His sisters were Selene (the moon) and Eos (dawn). The Greeks believed Helios, accompanied by Eos, drove a four-horse chariot across the sky each day. Each evening, a huge golden cup brought him back to his palace in the east on the river Oceanus. His daily journeys made him an all-seeing god, and the Greeks often called upon him to witness their oaths.

The island of Rhodes, in the Aegean Sea, was sacred to Helios. A famous statue of him stood there.

Nancy Felson

See also Phaëthon; Seven Wonders of the Ancient World (The Colossus of Rhodes).

Heliosphere is a vast, teardrop-shaped region of space containing electrically charged particles given off by the sun. The sun and all the planets are inside the heliosphere. The *nose* (blunt end) of the heliosphere is about 9 billion miles (15 billion kilometers) from the sun.

This distance is twice the greatest distance from the sun to Pluto. The tail of the heliosphere, which is opposite the nose, trails off into space at an even greater distance on the other side of the sun.

The sun and the heliosphere are traveling together—nose first—through a cloud in *interstellar space* (space between the stars). This cloud is a concentrated mass of the *interstellar medium,* dust and gas that occupy all interstellar space. The speed of the sun and heliosphere is about 16 miles (25 kilometers) per second.

Solar wind. Most of the particles given off by the sun are hydrogen *ions* (charged atoms), which have a positive electrical charge, and *electrons,* which are negatively charged. These particles constantly flow outward from the sun. Their flow through space is called the *solar wind.* The solar wind travels away from the sun at speeds of about 155 to 625 miles (250 to 1,000 kilometers) per second.

Shock waves. Due to the movement of the sun and heliosphere, the interstellar cloud and the solar wind push against each other. The amount of pressure exerted by the wind against the cloud can vary over time, and the regions of greatest pressure can change their locations. Occasionally, large outbursts of material from the sun, called *coronal mass ejections,* create ripples in the solar wind. The solar wind's pressure decreases as the wind expands into space.

Where the pressure of the cloud balances the pressure of the wind, particles in the wind slow down and heat up. As a result, the particles pile up, producing a shock wave called the *termination shock.* Farther out, in a region called the *heliosheath,* the wind continues to slow down. Finally, the wind stops its outward flow, and its particles merge with the interstellar cloud. The boundary where the merging occurs, called the *heliopause,* marks the end of the heliosphere.

There may also be a shock wave in the interstellar cloud in front of the heliopause. This kind of wave is called a *bow shock* because it resembles a wave made by the bow of a ship moving on the surface of the water.

Magnetic field. The flow of charged particles within and about the sun produces a *magnetic field,* a region where magnetic forces can be felt. The flow of the solar wind extends the sun's magnetic field into space as the *heliospheric magnetic field.*

The heliospheric magnetic field generally acts as a barrier to particles from beyond the heliosphere. There are three major exceptions: (1) tiny bits of material called *cosmic dust grains;* (2) electrically charged, high-energy particles called *cosmic rays;* and (3) *interstellar neutrals,* electrically neutral atoms from between the stars. Some interstellar neutrals eventually become cosmic rays.

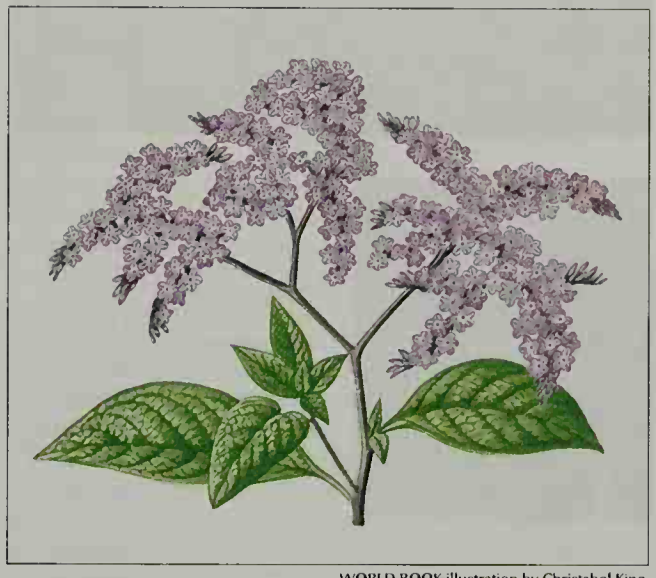
Probing the heliosphere. Four space probes launched in the 1970's will encounter the edge of the heliosphere sometime after 2000. Pioneer 11, Voyager 1, and Voyager 2 are traveling toward the nose, and Pioneer 10 is moving toward the tail. Scientists expect the Voyager probes to provide information about the termination shock and the heliopause. Pioneer 10's radio signal has become too weak to provide useful information. Pioneer 11 has run out of electric power.

The Ulysses space probe, launched in 1990, travels in a unique orbit that carries it over the north and south poles of the sun. This orbit enables it to sample the solar wind, dust grains, and cosmic rays in previously unexplored regions of the heliosphere. Antoinette B. Galvin

See also Cosmic rays (Anomalous component cosmic rays); Solar wind; Sun.

Heliotrope, *HEE lee uh trohp,* is the name of a large group of plants with fragrant flowers. These flowers always face toward the sun. Another name for heliotrope is *turnsole.* Both names mean *turning to the sun.*

There are about 250 species of heliotropes. Most of them are weeds, but some are cultivated. The most commonly cultivated species is native to Peru. It is a shrubby plant that grows from 1 to 3 feet (30 to 91 centimeters) tall. It has oval leaves with many veins visible on the surface. The tiny, fragrant flowers grow in large flattened clusters. Each flower consists of a short tube with five pointed lobes that give it a star-shaped appearance. They range in color from lavender to dark blue or, rarely, white. The fragrance of the Peruvian heliotrope is like that of vanilla or narcissus. James S. Miller



WORLD BOOK illustration by Christabel King

The heliotrope produces beautiful, fragrant flowers. The tiny star-shaped blossoms form large, colorful clusters on the plant.

Scientific classification. Heliotropes make up the genus *Heliotropium* in the family Boraginaceae. The scientific name for the Peruvian heliotrope is *H. arborescens.*

Helium, *HEE lee uhm,* is a lightweight gas and chemical element. Hydrogen is the only element that weighs less than helium. Helium is called an *inert gas* or *noble gas.* These terms are used because helium does not combine with other elements.

Helium makes up only a small fraction of the earth's matter. But it is one of the most common elements in the universe. The sun and other stars are made mostly of helium and hydrogen. The energy of these stars is produced when hydrogen atoms *fuse* (join together) to form helium atoms. This process is also what gives the hydrogen bomb its energy (see Nuclear weapon).

On the earth, helium occurs in natural gas deposits and in the atmosphere. The atmosphere contains about 5 parts of helium per million parts of air. Because helium is so light, it constantly escapes from the atmosphere and drifts into space. But the lost helium is replaced by radioactive minerals that shoot out *alpha particles* (heli-

Larry Day

U.S. Navy

Helium has several uses. In heliarc welding, *above,* a blanket of helium is blown over certain metals to protect them from oxygen in the air. A diver, *left,* sometimes breathes a mixture of helium and oxygen to prevent an illness called *nitrogen narcosis.*

um nuclei). Each alpha particle captures two electrons to form a complete helium atom.

In 1868, the astronomers Pierre J. Janssen of France and Sir Joseph Lockyer of the United Kingdom discovered helium in the sun while studying the sun with an instrument known as a spectroscope. Lockyer and Sir Edward Frankland, a British chemist, suggested the name *helium.* The name comes from the Greek word *helios,* which means *sun.* In 1895, helium was first found on Earth. The Scottish chemist Sir William Ramsay and the Swedish chemists Nils Langlet and Per Theodor Cleve discovered it in the mineral clevite.

Uses. About 700 million cubic feet (20 million cubic meters) of helium are used in the United States yearly. Federal agencies use about three-fourths of this amount, and private industries use the rest.

The government's chief use of helium is in maintaining the proper pressures in rockets. Pressure must be maintained in rocket fuel tanks during flight, or the thin walls of the large tanks might collapse as the fuel drains from them. Helium also produces the pressure that forces fuel into rocket pumping systems.

The largest industrial use of helium is in *heliarc welding* (a type of electric arc welding). The inert helium keeps oxygen in the air from reaching the metal. If oxygen reaches the metal, it may cause the metal either to burn or to corrode. Helium is used to prevent chemicals from reacting with other elements during storage, handling, and transportation.

Helium is also used to fill scientific balloons. The balloons rise to high altitudes because helium is lighter than air. In air, helium has 92 percent of the lifting ability of hydrogen. It is safer than hydrogen because it will not burn, as hydrogen will.

Persons with asthma or other breathing difficulties must sometimes inhale a mixture of helium and oxygen. The mixture enters the lungs more easily than air because the helium atoms are lighter than the nitrogen molecules of the air. Divers sometimes breathe a mixture of helium and oxygen to avoid a painful illness called *nitrogen narcosis.* Nitrogen narcosis usually occurs at depths below 100 feet (30 meters). The pressure of the water on divers' bodies forces bubbles of nitrogen gas from the air into their blood when they breathe. The blood carries the nitrogen to the brain. This illness causes the divers to lose the ability to think clearly, and they may do dangerous things or pass out.

Production. Most of the world's helium comes from five U.S. natural-gas fields: (1) the Cliffside field in the Texas Panhandle, (2) the Greenwood field in Kansas and Colorado, (3) the Hugoton field in Kansas, Oklahoma, and Texas, (4) the Keyes field in Oklahoma, and (5) the Panhandle field in Texas. These fields have an estimated 180 billion cubic feet (5 billion cubic meters) of helium. U.S. helium plants produce about 2 billion cubic feet (57 million cubic meters) of helium each year.

Natural gas from some wells contains up to 8 percent helium. Helium is purified by cooling the natural gas until all gases except helium, argon, hydrogen, and nitrogen changes to liquid. Hydrogen is then burned out of the remaining mixture, and argon is absorbed by charcoal at low temperatures. Nitrogen often remains in helium as an impurity.

Properties. Helium is a colorless, odorless, and tasteless gas. Its chemical symbol is He. Its *atomic number* (number of protons in its nucleus) is 2. Its *relative atomic mass* is 4.002602. An element's relative atomic mass equals its *mass* (amount of matter) divided by $\frac{1}{12}$ of the mass of carbon 12, the most abundant form of carbon. Helium's density is 0.1664 milligram per cubic centimeter at 20 °C. It becomes liquid when it is cooled to −268.9 °C, about 4 °C above absolute zero. Because helium can be cooled to such a low temperature without freezing, it is used as a liquid refrigerant in low temperature devices and in cryogenics research (see **Cryogenics**). In addition, helium is the only chemical element that cannot be changed to a solid by cooling alone under ordinary pressures. It must be cooled and compressed. It freezes solid at −272.2 °C under a pressure of 26 times atmospheric pressure.

Liquid helium is one of the strangest of all liquids. Unlike most liquids, it conducts heat extremely well, it flows toward relatively warm places, and it expands instead of contracting when it cools. Liquid helium forms a film over everything it touches. This film can act as a siphon, carrying helium over the side of a container to a lower level. Frank C. Andrews

See also **Airship; Balloon; Element, Chemical** (Periodic table); **Ramsay, Sir William; Superfluid.**

Hell, according to many religions, is a place or state inhabited by demons, in which wicked people are punished after death. Hell is also a symbol of the most powerful opposition to goodness and justice.

In Old Testament times, the Israelites believed that all the dead, both good and evil, went to a dark, unhappy place called *Sheol.* By the time of Christ, some Jews

thought that after death the wicked were separated from the righteous and then cast into a foul, burning valley called *Gehenna.*

Hell is no longer prominent in the teachings of Judaism, but Gehenna became synonymous with hell in Christianity and Islam. According to traditional Christian belief, hell is a place of unending anguish and pain caused by the loss of happiness and separation from God. However, some Christian theologians have questioned whether a just and loving God would have created such a place. According to these scholars, hell is not a place but a symbol of the anguish caused by the loss of God or goodness. Islam, the religion of the Muslims, regards hell as a vast, fiery crater that the souls of the dead cross on a narrow bridge. The wicked fall off the bridge into everlasting torment.

In Hinduism and Buddhism, a soul may descend into one of many hells as a result of wicked *karma* (thoughts, words, and deeds). The stay in hell is not eternal. It lasts only until the effects of the evil karma have been removed. J. H. Charlesworth

See also **Religion** (A doctrine of salvation); **Divine Comedy; Hades; Limbo; Purgatory.**

Hellebore, *HEHL uh bawr,* is the common name of a genus of plants in the crowfoot family. They are native to Europe and Asia and grow in some areas of North America. They have thick, fibrous roots and large flowers. The *Christmas rose,* or *black hellebore,* blooms from late fall to early spring. Its white or pale purple flowers look like single roses. Its roots and leaves contain a poison.

False hellebores, which are not related to the true hellebores, are found in Europe, Asia, and North America. The *American white hellebore,* or *Indian poke,* is 2 to 8 feet (0.6 to 2.4 meters) high and has small green or greenish-yellow flowers. Its roots are dried and ground to powder for use as an insecticide. Kenneth A. Nicely

Scientific classification. Hellebores make up the genus *Helleborus* in the crowfoot family, Ranunculaceae. The scientific name for the Christmas rose is *H. niger.* False hellebores are in the lily family, Liliaceae.

Hellenes. See **Greece, Ancient.**

Hellenistic Age was a period in ancient history when Greek culture dominated much of what was then the civilized world. It began after the death of Alexander the Great in 323 B.C., and lasted nearly 200 years in Greece and almost 300 years in the Near East.

The Hellenistic Age was a period of great achievement in scholarship, science, and the arts. The mathematician Euclid developed the principles of geometry, and the mathematician and inventor Archimedes discovered many basic laws of physics. The astronomer Aristarchus of Samos suggested that all the planets, including the earth, revolve around the sun. The mathematician Eratosthenes made a reasonably correct calculation of the earth's polar circumference.

Paintings and sculpture became more realistic. Hellenistic sculptors created such masterpieces as the *Laocoön* and the *Winged Victory of Samothrace.*

Philosophers were concerned with how people could achieve peace of mind. The major groups were (1) the Stoics, (2) the Epicureans, and (3) the Cynics. *Stoics* believed happiness resulted when people learned to accept events beyond their control and did their duty. *Epicureans* sought pleasure in moderation and avoidance of pain. *Cynics* tried to disregard all desires and pursued virtue. For religion, many people worshiped such Egyptian divinities as Isis and Serapis.

Earlier, Greece had been divided into independent *city-states,* each of which consisted of a city and its surrounding territory. During the Hellenistic Age, the city-states lost their independence. They came under the control of monarchies that governed large kingdoms. Some monarchs claimed to rule by divine right.

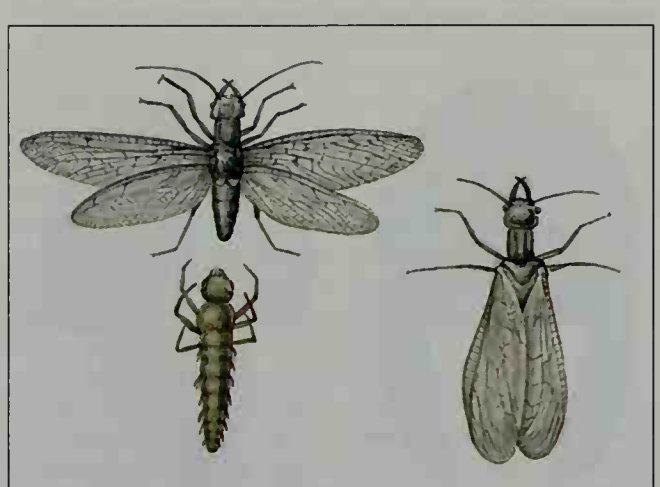
The major dynasties of the age were the Ptolemies of Egypt, Antigonids of Macedonia, Seleucids of Syria, and Attalids of Pergamum (now western Turkey). They fought against each other and among themselves. This disunity helped the Romans conquer most of the Hellenistic world in the 100's B.C. Donald Kagan

See also **Greece, Ancient** (The Hellenistic Age); **Sculpture** (Hellenistic sculpture).

Heller, Joseph (1923-1999), was an American novelist who established his reputation with the comic novel *Catch-22* (1961). The title describes the accumulated absurdities that characterize many complex organizations. The novel is set during World War II (1939-1945) and describes the misadventures of Yossarian, a U.S. officer. His ways of retaining his identity depend on an ability to maneuver within an illogical military system. *Closing Time* (1994) is a sequel to the novel.

In *Something Happened* (1974), Heller imagined the psychological pressures faced by an American business executive. *Good as Gold* (1979) describes the personal and professional problems of an American college professor. *God Knows* (1984) is a comic novel in the form of an autobiography of the Biblical leader King David. With Speed Vogel, Heller wrote *No Laughing Matter* (1986), an autobiographical account of Heller's battle against a paralyzing illness. Heller's *Picture This* (1988) is a novel about the Dutch painter Rembrandt that is also a meditation about art. Heller wrote an autobiography, *Now and Then: From Coney Island to Here* (1998). He was born in the Brooklyn section of New York City. Victor A. Kramer

Hellgrammite, *HEHL gruh myt,* is the wormlike *larva* (immature stage) of the four-winged insect known as the dobsonfly. Hellgrammites live under stones in swift streams of North America. They have strong jaws and



WORLD BOOK illustration by Shirley Hooper, Oxford Illustrators, Limited

Hellgrammite is the large black larva of an insect called the dobsonfly. Hellgrammites live in swift streams in North America.

prey on small aquatic organisms. They are a popular fishing bait because they wriggle about on the bait hook. When hellgrammites are fully grown, they leave the water, pupate for about two weeks, and emerge as dobsonflies.

Scientific classification. The dobsonfly belongs to the order Neuroptera or Megaloptera. Its scientific name is *Corydalus cornutus.* E. W. Cupp

Hellman, Lillian (1905-1984), was an American playwright. Her work combines tightly woven plots with insight into psychological weakness and a deep concern with the social issues of her time.

Hellman's plays of the 1930's and 1940's focus on destructive selfishness and greed. In *The Children's Hour* (1934), a spoiled, disturbed girl ruins the lives of two women teachers by spreading rumors that they have a lesbian relationship. In *The Little Foxes* (1939), material greed and lust for power create tragic conflicts in a Southern family. *Another Part of the Forest* (1946) shows the roots of the family's materialism in the deeds of the preceding generation. The family symbolizes Hellman's disapproving view of the immorality she saw unleashed by America's materialism and by the dominance of greed over humane values. In *Watch on the Rhine* (1941), the destructive evil of the Nazis disrupts the sheltered lives of a family in suburban Washington, D.C. Hellman's other plays include *The Autumn Garden* (1951) and *Toys in the Attic* (1960).

In the 1970's, Hellman achieved new recognition for her autobiographical writings. They include *An Unfinished Woman* (1969), an autobiography; *Pentimento* (1973), a series of portraits of people she had known; and *Scoundrel Time* (1976). This last book is a memoir of Hellman's involvement in congressional investigations of Communist influence in the United States. Hellman was born in New Orleans. Albert Wertheim

Helmet is a covering of metal or other sturdy material designed to protect the head. Most helmets have soft liners so they may be worn comfortably. Many people wear helmets, including firefighters, police, motorcyclists, and construction workers. Athletes in certain sports wear helmets. Astronauts wear special helmets for space travel. In tropical climates, *pith helmets* or *cork helmets* provide protection from the sun.

Helmets once were worn only in war. The first helmets, worn by Ethiopian soldiers, were the skulls of

© Don Eaton, Higgins Armory Museum

A gladiator's helmet shielded a warrior who fought battles staged as entertainment for the ancient Romans.

Bequest of George C. Stone, 1936, The Metropolitan Museum of Art

Chinese helmet

Rogers Fund, 1904, The Metropolitan Museum of Art

Turkish helmet

© Michael T. J. Kulik

Modern combat helmet

AP/Wide World

Football helmet

Fletcher Fund, 1935, The Metropolitan Museum of Art

Greek helmet

Fletcher Fund, 1926, The Metropolitan Museum of Art

Roman helmet

© Mine Safety Appliances Company

Miner's helmet

NASA

Astronaut's helmet

horses, complete with mane and ears. The ancient Assyrians, Greeks, and Romans wore dome- or cone-shaped helmets made of bronze. Knights in the Middle Ages wore helmets of chain mail or plated steel. They were dome-shaped so that sword blows glanced off the surface. In many cases, the helmet covered the entire head, leaving only slits or holes for seeing and breathing. Some helmets were attached to body armor so they could not be knocked off.

Combat soldiers in World Wars I and II wore steel helmets that could also be used as a cooking pot, dish, or wash basin. Since 1978, soldiers in the United States Army have worn helmets made of an acrylic fiber that is stronger than steel. Karin N. Mango

See also **Armor**; **Bronze** (picture: Bronze helmet).

Helmholtz, *HEHLM hohlts,* **Hermann Ludwig Ferdinand von,** *HEHR mahn LOOT vihk FEHR dih nahnt fuhn* (1821-1894), a German physicist, helped establish the law of the conservation of energy (see **Energy** [The conservation of energy]). His research on sound ranked as the outstanding work of his time in acoustics. He was the first scientist to apply physical methods to the study of the nervous system by measuring the speed of nerve impulses. Helmholtz also invented the ophthalmoscope, used by doctors to examine eyes. He was born in Potsdam. See also **Color** (The three-component theory); **Ophthalmoscope**; **Heat** (Learning about heat).

Richard G. Olson

Helms, Jesse Alexander (1921-), has been a United States senator from North Carolina since 1973. He was the first Republican elected to the Senate from his state since 1895. Helms attracted a wide following among conservatives and became one of the most influential senators in the 1980's, during the administration of President Ronald Reagan. Helms served as chairman of the Senate Foreign Relations Committee from 1995 to 2001. He had served as chairman of the Senate Committee on Agriculture, Nutrition, and Forestry from 1981 to 1987.

Helms favors outlawing abortion at any time during a pregnancy. He believes that human life, as protected by the U.S. Constitution, begins at the time of conception, when a sperm fertilizes an egg. He has called for permitting prayer in public schools, prohibiting busing of students solely to achieve racial integration, and a balanced federal budget.

Helms was born in Monroe, North Carolina. He served on the Raleigh (North Carolina) City Council from 1957 to 1961. From 1960 until his election to the U.S. Senate in 1972, Helms was an executive and commentator for the Capitol Broadcasting Company in Raleigh.

Lee Thornton

Helsinki, *HEHL sihng kee* or *hehl SIHNG kee* (pop. 508,588; met. area pop. 888,871), is the capital and largest city of Finland. It is also one of the nation's chief ports and the heart of its commercial and cultural life. Nearly 20 percent of the Finnish people live in Helsinki or its suburbs. The city lies on the southern coast of the country, on the Gulf of Finland, and occupies a peninsula and several islands. For location, see **Finland** (political map).

Helsinki is a city of scenic bays and broad, treelined streets. The contrast of old and new architecture adds to its charm. The center of the city's old section is Senate Square, which has many buildings designed in the neo-classical style of the 1800's. They include the Government Palace and the towering Lutheran Cathedral. The main business districts of Helsinki are west of Senate Square. These newer sections of the city include buildings designed by some of the finest modern architects. Most of Helsinki's people live in apartments. In the last half of the 1900's, many apartment buildings were converted to office buildings. Large numbers of people moved to various suburbs. The suburbs include outstanding examples of city planning.

J. Messerschmidt, Bruce Coleman Inc.

The Cathedral of Helsinki towers over the city's harbor. Helsinki is famous for its many beautiful buildings.

Universities in Helsinki include the Technical University and the University of Helsinki, which is Finland's principal university. The city has many theaters and several art galleries and museums. Its islands and parks have facilities for boating, skiing, and other sports.

Most of the city's people work for the government or in commerce, communications, and service occupations. Industrial employment has declined because some manufacturers have moved from the city to the suburbs. But Helsinki remains the main Finnish industrial area. Its chief products include ceramics, clothing, machinery, paper, plywood, refined sugar, and ships.

Helsinki was founded in 1550 by King Gustav I Vasa of Sweden, which then ruled Finland. Russia and Sweden fought numerous wars in Finland from the 1500's through the 1700's, and Helsinki twice was nearly destroyed in the fighting. The city passed from Swedish to Russian rule in 1809. In 1812, Czar Alexander I made Helsinki the capital of Finland and ordered a large-scale program of city planning and construction. Many of the impressive buildings around Senate Square were erected at that time. By 1900, Helsinki had become an industrial city with a population of more than 100,000.

Finland gained independence from Russia in 1917, and the Helsinki region began to increase in population and commercial importance. Today, Helsinki is the site of many international conferences. A striking convention center in the city is built in the shape of a grand piano.

Pekka Kalevi Hamalainen

See also **Finland** (Climate; pictures).

Helsinki Accords, *HEHL sihng kee,* consist of several international agreements reached by the Conference on Security and Cooperation in Europe (CSCE) in the 1970's and 1980's. The CSCE is now known as the Organization on Security and Cooperation in Europe. The first and most important of the accords pledged increased cooperation between the nations of Eastern and Western Europe. The chief agreement was signed in Helsinki, Finland, on Aug. 1, 1975, by Canada, the United States, the Soviet Union, and the 32 other members of the CSCE, almost all of which were European countries. See Organization for Security and Cooperation in Europe.

The official name of the chief agreement is the Final Act of the Conference on Security and Cooperation in Europe. The Final Act covered many issues. But its main goal was to reduce international tensions associated with the Cold War. The act resulted in the Western countries' finally recognizing Eastern European boundaries that had been set up after World War II ended in 1945. In addition, all signers promised to respect human rights, including their citizens' freedoms of thought and religion. The signers also agreed to increase economic and cultural cooperation, to protect the rights of journalists, and to encourage educational exchanges.

After the Final Act was signed, each side charged that the other routinely violated its provisions. For example, the Soviet Union claimed that Western governments' support for Soviet Jews who opposed certain Soviet laws violated a provision against one country's interfering in the internal affairs of another. The Western countries claimed that the same provision prohibited the Soviet invasion of Afghanistan in 1979.

The Final Act led to increased popular demand for the exercise of human rights in Eastern Europe and the Soviet Union. This demand became a major cause of the democratic revolutions that brought non-Communist governments to power in many Eastern European nations in 1989 and the early 1990's. The demand also helped bring the Soviet Communist Party's fall from power in August 1991. These developments contributed to a sharp improvement in Western countries' relations with Eastern European nations—and with the Soviet Union before it broke up in late 1991. Gary B. Ostrower

Helvetians, *hehl VEE shuhnz,* were members of a tribe that lived in what is now northwestern Switzerland. Threatened by Germanic tribes, they tried to migrate into Gaul (now mainly France), part of which was controlled by Rome. But troops led by Roman general Julius Caesar defeated the Helvetians in 58 B.C., and the Helvetians were forced to return home. Under Augustus, emperor from 27 B.C. to A.D. 14, Rome conquered Switzerland. As a result, the Helvetians adopted Rome's customs and its Latin language. Today, the French-speaking people of western Switzerland sometimes refer to their area as *Helvetia.* Arthur M. Eckstein

Hematite, *HEHM uh tyt,* is a mineral that supplies most of the world's iron. Hematite is a *ferric oxide* (a compound of iron and oxygen) and has the chemical formula Fe_2O_3. In its purest form, hematite consists of about 70 percent iron. The mineral occurs in a variety of forms, including shiny crystals; grainy rock; and loose, earthy material. Hematite is black, brownish-red, or dark red in color, but a fresh scratch on hematite rock is blood-red. The word *hematite* means *bloodlike. Red ocher,* an earthy form of hematite, is used to color paint.

About 20 percent of the iron produced in North America comes from hematite. Deposits of the ore lie near Lake Superior in Michigan, Minnesota, and Wisconsin; and in Alabama and Tennessee. Large amounts of hematite also occur near the border of Labrador and Quebec, and in Ontario. Other sources include Australia, Brazil, and South Africa. Robert B. Cook

Hemingway, Ernest (1899-1961), was one of the most famous and influential American writers of the 1900's. He received the Nobel Prize for literature in 1954. He won a Pulitzer Prize for his novel *The Old Man and the Sea* (1952).

Look Magazine from UPI

Ernest Hemingway

Hemingway used a plain, forceful prose style characterized by simple sentences and few adjectives or adverbs. He wrote crisp, accurate dialogue and exact descriptions of places and things. His style has been widely imitated.

Hemingway also created a type of male character, sometimes called the *Hemingway hero,* who faces violence and destruction with courage. The trait of "grace under pressure"—that is, what appears to be unemotional behavior even in dangerous situations—is part of what became known as the *Hemingway code.*

Early life. Ernest Miller Hemingway was born in Oak Park, Illinois. After graduating from high school, he worked briefly as a reporter for the *Kansas City Star.* In 1918—during World War I—he served as a Red Cross volunteer in Italy, driving an ambulance and working at a canteen. After working in Italy for six weeks, he was seriously wounded. Hemingway's wartime experiences help suggest why his writing emphasizes physical and psychological violence and the need for courage.

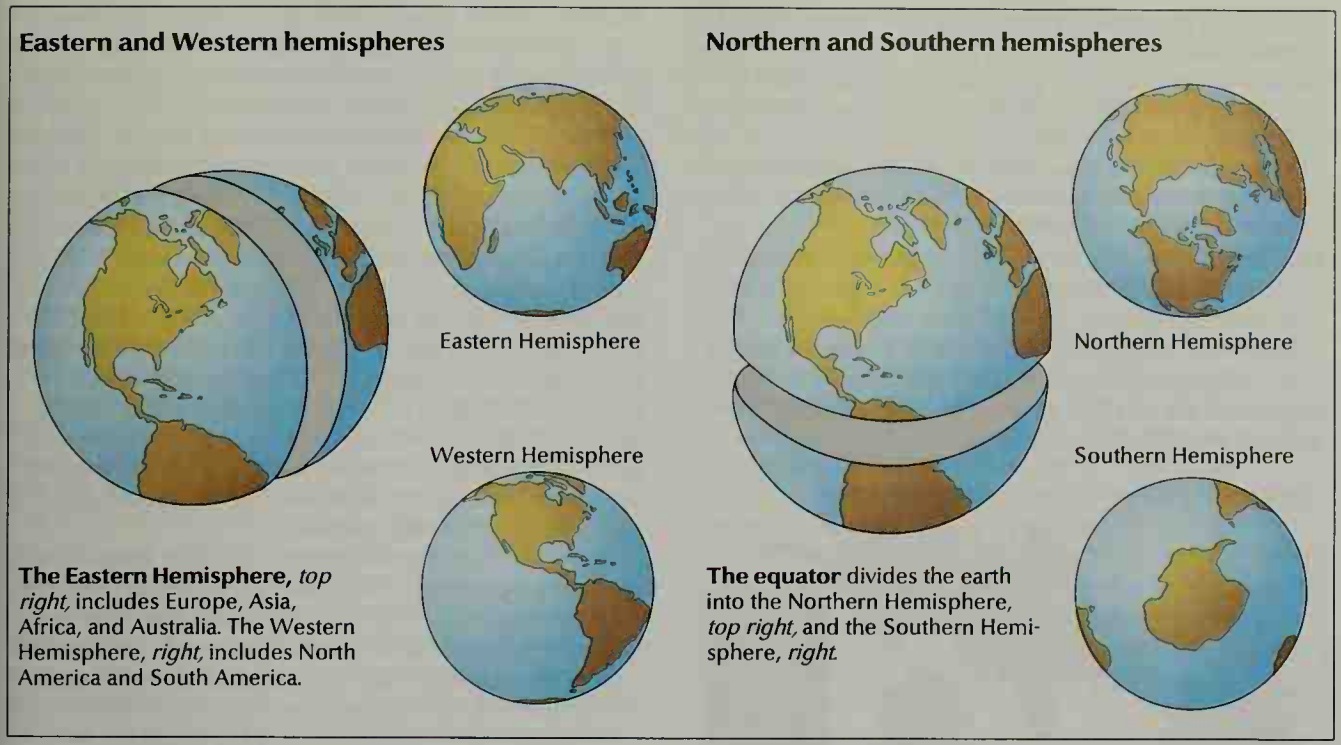
In 1921, Hemingway went to Paris, where he met a number of American authors. He became the principal spokesman for a group of disillusioned younger writers sometimes called the "Lost Generation."

Hemingway's first published work, *Three Stories and Ten Poems,* appeared in 1923. It was followed by *In Our Time* (1924), a collection of short stories partly based on his boyhood experiences in northern Michigan.

Rise to fame. Hemingway's most famous novels are two of his early works, *The Sun Also Rises* (1926) and *A Farewell to Arms* (1929). *The Sun Also Rises* portrays a group of Americans who, like the members of the "Lost Generation," were disillusioned by the war. *A Farewell to Arms,* set in Italy in World War I, is a tragic love story.

Hemingway returned to the United States in 1927. Two collections of his short stories were published during the 1930's. They contain some of his best writing, including "A Clean, Well-Lighted Place," "The Short Happy Life of Francis Macomber," and "The Snows of Kilimanjaro." He also wrote some nonfiction. *Death in the Afternoon* (1932) deals with bullfighting, which fascinated him. In *Green Hills of Africa* (1935), Hemingway described his experiences on an African safari.

In 1936, Hemingway went to Spain and covered the



The Eastern Hemisphere, *top right,* includes Europe, Asia, Africa, and Australia. The Western Hemisphere, *right,* includes North America and South America.

The equator divides the earth into the Northern Hemisphere, *top right,* and the Southern Hemisphere, *right.*

Spanish Civil War as a war correspondent. He used the war as the setting of *For Whom the Bell Tolls* (1940). This novel, about an idealistic American fighting the fascist forces in Spain, is one of Hemingway's finest books.

Later years. By the 1940's, Hemingway had become an international celebrity. He was famous for his colorful lifestyle and his extreme concern with presenting a tough, masculine image.

Hemingway's first published work after 1940 was *Across the River and Into the Trees* (1950). This novel reflects a growing bitterness toward life. It is largely regarded as inferior because of its sentimentality. In *The Old Man and the Sea* (1952), he revived his theme of a strong man courageously accepting fate. The hero, an old fisherman, catches a giant marlin after a long and brutal struggle—only to have the fish eaten by sharks.

Hemingway suffered physical and mental illnesses during the 1950's. He committed suicide in 1961. *A Moveable Feast* was published in 1964. It is an autobiographical book based on notebooks he kept in Paris in the 1920's. Two novels were also published after his death—*Islands in the Stream* (1970) and the unfinished *The Garden of Eden* (1986). Victor A. Kramer

See also Lost Generation.

Additional resources

Mandel, Miriam. *Reading Hemingway.* Scarecrow, 1995.
Reynolds, Michael S. *Hemingway: The American Homecoming.* Blackwell, 1992. *Hemingway: The 1930s.* Norton, 1997. *Hemingway: The Paris Years.* Blackwell, 1989. *The Young Hemingway.* 1986. Reprint. Norton, 1998.

Hemisphere, *HEHM uh sfihr,* is the name given to any half of the globe. It comes from a Greek word that means *half a sphere.* There are three main ways in which the earth is divided into hemispheres.

Geographers have not definitely established boundaries between the Eastern and Western hemispheres. But they usually draw them along the meridians of 20° west longitude and 160° east longitude. The Eastern Hemisphere, or Old World, includes the continents of Europe, Asia, Africa, and Australia. North America and South America are in the Western Hemisphere, or New World.

Geographers also divide the earth into hemispheres by using the equator as a boundary line. All areas north of the equator make up the Northern Hemisphere. All areas to the south make up the Southern Hemisphere.

The earth may also be divided into a land hemisphere and a water hemisphere. The land hemisphere includes the half of the earth with the most land. Its center lies near London, England. The other half of the earth, mostly water, makes up the water hemisphere. Its center lies near New Zealand. Judy M. Olson

Hemlock, also called *poison hemlock,* is a poisonous herb. Hemlock lives for two to several years and then flowers, produces fruit, and dies. It has many branches, purple-spotted hollow stems, and numerous clusters of small, white flowers. It grows up to 8 feet (2.4 meters) high. Its egg-shaped fruits are about $\frac{1}{8}$ inch (3 millimeters) long and ripen in July and August. Its leaves look like those of parsley, for which it is often mistaken. But hemlock can be quickly recognized by its disagreeable odor that becomes quite strong when the leaves or stems are bruised. The plant is native to Europe, Asia, and some parts of Africa. It also has been introduced into North America.

Kitty Kohout, Root Resources

Poison hemlock

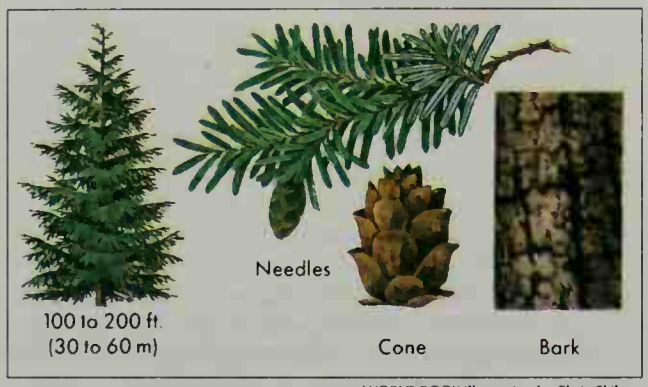
People mistaking hemlock for parsley may be poisoned. Children are sometimes poisoned by hemlock when they make

whistles or peashooters from its hollow stems. The plant can be killed by spraying with 2,4-D. The ancient Greeks made a poisonous brew from hemlock and gave it to criminals condemned to death. The philosopher Socrates died by drinking this brew.

Scientific classification. Poison hemlock belongs to the parsley family, Apiaceae or Umbelliferae. It is classified as *Conium maculatum.* Jerry M. Baskin

Hemlock is the common name of stately evergreen trees belonging to the pine family. They grow in the forests of North America, Japan, China, and India.

Hemlocks have blunt, soft needles. These are joined to the twig by small woody stalks that remain on the twig when the needles fall off. These small, peglike projections are a distinctive feature.



WORLD BOOK illustration by Chris Skilton

The western hemlock is a valuable timber tree.

Eastern, or *Canadian, hemlock* ranges from southern Canada to the mountains of Georgia. It may live up to 800 years. It is a medium-to-large tree with a dense, pyramid-shaped crown. Its short, dark-green needles grow in two rows. Each needle has two whitish bands on its lower surface. The bark of this hemlock is an important source of tannin for the leather industry. The wood is soft, and splinters easily. It is used for building frames and clapboards. This kind of hemlock is the state tree of Pennsylvania.

Carolina hemlock is a handsome but rare tree found high in the Appalachian Mountains from Virginia to northern Georgia. The dark green needles extend from all sides of the twig instead of appearing in two rows. *Western hemlock* is an important tree of the Pacific Northwest and is the state tree of Washington. It resembles the Canadian hemlock, but is larger. It can grow to a height of 200 feet (60 meters) with a trunk diameter of 8 feet (2.4 meters). Its wood is valued both for lumber and for pulp. *Mountain hemlock* is found in the mountains from Alaska to California. It grows on ridges exposed to severe weather.

Scientific classification. Hemlocks belong to the pine family, Pinaceae. The Eastern hemlock is *Tsuga canadensis.* Carolina hemlock is *T. caroliniana.* Western hemlock is *T. heterophylla,* and mountain hemlock is *T. mertensiana.* Ross W. Wein

See also **Conifer; Tree** (Familiar broadleaf and needleleaf trees of North America [picture]).

Hemoglobin, *HEE muh GLOH buhn,* is the pigment that transports oxygen in the blood. It is in the red blood cells and gives blood its red color. When the red cells file through the *alveoli,* or air sacs, of the lungs, they take up oxygen. The hemoglobin combines with the oxygen to form a compound called *oxyhemoglobin.* When the red cells travel through the rest of the body, they give up the oxygen to the tissues. In the tissues, the hemoglobin takes up carbon dioxide, and releases it in the alveoli of the lungs. The carbon dioxide is then exhaled.

Hemoglobin is a complex molecule that includes iron and a protein called *globin.* Anemia may result from a lack of hemoglobin or from hereditary abnormalities in the hemoglobin (see **Anemia**). Some poisons combine with hemoglobin in a way that it can no longer combine with oxygen. Thus, aniline dyes and other chemicals cause the formation of *methemoglobin,* which cannot take up oxygen. The blood then turns bluish-brown. Carbon monoxide, a poisonous gas, mixes readily with hemoglobin, making the blood bright-red. But the gas keeps blood from taking up oxygen.

Scientists have identified many different kinds of hemoglobin. A person's hemoglobin type is inherited. *Hemoglobin A* ranks as the most common type. One abnormal type, called *hemoglobin S* or *sickle hemoglobin,* causes the disease sickle cell anemia. Red blood cells that contain mostly hemoglobin S may become stiff and misshapen. These cells may then plug blood vessels. See **Sickle cell anemia.** Joseph V. Simone

See also **Blood; Hemolysis; Iron; Perutz, Max F.**

Hemolysis, *hih MAHL uh sihs,* is the breakdown of red blood cells. Hemolysis causes red blood cells to release *hemoglobin,* the red pigment that carries oxygen to body tissues (see **Hemoglobin**). Hemolysis in small amounts is normal. About 1 per cent of all red cells in the body are *hemolyzed* (broken down) daily. Usually, hemolysis is balanced by the production of new red blood cells in the *marrow* (center part) of the bones. But if too many red cells break down, the production level may be insufficient, resulting in anemia. Causes of excessive hemolysis include blood poisoning, certain chemicals, hereditary blood disorders such as sickle cell anemia, and the presence of abnormal antibodies that destroy the red cells. Dominick Sabatino

Hémon, *ay MAWN,* **Louis,** *lwee* (1880-1913), was a French author best known for his novel *Maria Chapdelaine.* This book describes the hardships of *habitants* (French-Canadian farmers) in the harsh climate of the Lac Saint-Jean region of southern Quebec. It is a classic portrait of the spirit and traditions of the habitants.

Hémon was born in Brest. In 1902, he moved to London, where he wrote for a newspaper. Hémon emigrated to Canada in 1911 and worked on a farm near Roberval, Que., for several months. He based *Maria Chapdelaine* on his experiences on the farm. Hémon died in a train accident shortly after completing the novel and mailing it to a French magazine. The magazine published the work in 1914. It appeared in book form in 1916. Rosemary Sullivan

Hemophilia, *HEE muh FIHL ee uh,* is a hereditary disease in which the blood does not clot normally. People with hemophilia, called *hemophiliacs,* bleed excessively when injured because their blood clots extremely slowly. Almost all hemophiliacs are males.

Blood must contain a number of substances called *clotting factors* for clotting to take place. A hemophiliac's blood lacks the active form of one of these factors.

Hemophiliacs suffer most when internal blood vessels break, causing bleeding into such areas as the head or joints. Leaking blood accumulates in these areas, putting pressure on the surrounding tissues and causing pain, swelling, and loss of function. Many hemophiliacs become crippled from repeated bleeding into joints. Some people believe that hemophiliacs can bleed to death from even a small external cut. However, such deaths do not occur because blood contains clotting factors that halt bleeding from the skin.

How hemophilia is inherited. Hemophilia is caused by a defective gene on the *X chromosome,* one of the two chromosomes that determine a person's sex (see **Heredity** [Patterns of heredity]). The *Y chromosome,* which has no genes for clotting factors, is the other. Males have one X chromosome and one Y chromosome. Females have two X chromosomes.

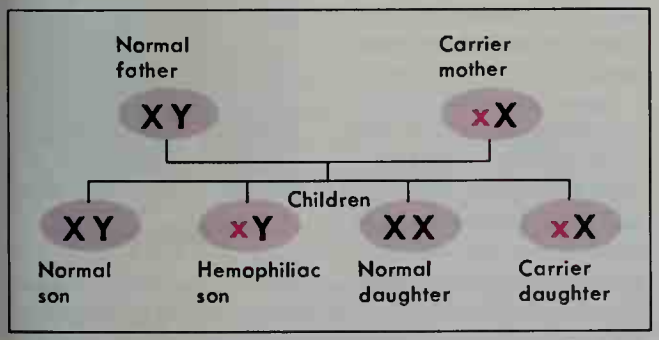
A boy who inherits the hemophilia defect on his X chromosome will be a hemophiliac. A girl who inherits the defective gene on one of her X chromosomes will be a *carrier.* She may transmit the defective gene to her children. But she will not be a hemophiliac because the normal gene on her other X chromosome provides enough of the essential clotting factor. In extremely rare cases, a girl inherits the defective gene on both X chromosomes and will be a hemophiliac.

Major types of hemophilia include classical hemophilia and Christmas disease. The name of Christmas disease comes from the last name of one of the first patients to be treated for it. About 85 per cent of all hemophiliacs have classical hemophilia. Their blood lacks a protein called *clotting factor number 8.* Nearly all others have Christmas disease, which involves the lack of *clotting factor number 9.* An extremely small number of hemophiliacs lack another kind of clotting factor.

A blood disorder called *von Willebrand's disease* is sometimes confused with hemophilia. Unlike hemophilia, von Willebrand's disease causes prolonged external bleeding and affects both sexes. But few people with this blood disorder suffer bleeding into the joints.

Hemophilia

Hemophilia is a hereditary disease in which the blood does not clot normally. It results from a defective gene on the X chromosome, one of two sex chromosomes. Males have one X and one Y chromosome. Females have two X chromosomes.



WORLD BOOK diagram

In the chart above, the small red x indicates the chromosome with the defect. A male who inherits the defective gene has hemophilia. A female who inherits it on only one X chromosome is a *carrier.* She does not have the disease, but she can pass the defective gene on to her children. Each son of a normal father and a carrier mother has one chance in two of being a hemophiliac. Each daughter has one chance in two of being a carrier.

Treatment for hemophilia consists of injections of the clotting factor that is lacking in the blood. The injections, which are made from donated blood, temporarily cause normal clotting. Treatment should be given soon after an injury, so that blood does not accumulate and thus damage body tissues. Many hemophiliacs keep a supply of clotting factor and inject themselves.

During the early and mid-1980's, hundreds of hemophiliacs became infected with the AIDS (acquired immunodeficiency syndrome) virus after receiving clotting factor contaminated with the virus. Since 1985, blood banks process clotting factor from donated blood to destroy the AIDS virus, greatly increasing the safety of treatment. In addition, clotting factor produced in the laboratory through techniques of genetic engineering is available for hemophilia treatment. David Green

See also **AIDS; Bleeding; Blood** (Bleeding disorders).

Hemorrhage, *HEHM uh rihj,* is bleeding, either within the body tissues or from the body surface. Severe hemorrhage may bring on dizziness or a sick feeling. Patients become pale, and their pulse and breathing are weak and rapid. They may go into a condition of shock. Loss of too much blood will result in death.

James N. Davis

See also **Bleeding; Cerebral hemorrhage.**

Hemorrhoids, *HEHM uh roydz,* are enlargements of the veins of the rectum. This condition is often called *piles.* There are two sets of veins in the rectum. The *internal veins* line the lower rectum and extend upward. The *external veins* lie beneath the skin at the *anus* (rectal opening). When any of these veins *dilate* (enlarge), they become hemorrhoids.

Many people seem to inherit a tendency toward developing hemorrhoids. However, any condition that causes prolonged or repeated increases in the blood pressure in the rectal veins may contribute to the development of hemorrhoids. Such conditions include constipation, pregnancy, and long periods of standing.

Hemorrhoids of the external veins usually cause little discomfort unless a blood clot forms in the affected vein and results in inflammation. Hemorrhoids of the internal veins may bleed or descend through the anus as a result of bowel movements. Such hemorrhoids may cause pain or itching. Mild cases can be treated with medicated ointments or *suppositories* (inserted capsules), or by soaking in warm water. If the victim repeatedly suffers painful attacks or bleeding, a physician may remove the hemorrhoids surgically. Richard H. Dean

Hemp is a plant sometimes grown for its strong fiber. Hemp fibers are obtained from the plant's woody stem and are used to make ropes, cords, and twines. The hemp plant is native to central and western Asia, and it was once cultivated in many temperate and tropical regions worldwide. But the plant became less important after the development of synthetic fibers as strong or stronger than hemp fibers. Hemp is still grown for its fiber in some countries. Its cultivation is restricted in the United States because two illegal drugs, marijuana and hashish, are obtained from hemp plants.

The hemp plant is an *annual*—that is, it lives only one growing season. It grows best in a moist, mild climate. In regions where hemp is grown commercially, some hemp plants are raised for their seeds, and some are raised for their fiber. Both seed and fiber hemp have

their pollen, or *staminate,* flowers on different plants from those that produce the seed, or *pistillate,* flowers. Pollen flowers are yellowish-green and grow in clusters.

Fiber hemp can be sown by scattering the seed on the ground. Each seed grows to a slender stem 4 to 12 feet (1 to 4 meters) high. Seed hemp is planted in furrows with earth covering them. The stalk reaches a height of 10 to 20 feet (3 to 6 meters). It is thicker than the fiber-hemp stalk and has many branches.

Hemp is harvested in industrialized countries by harvesting machines that mow the stalks and spread them in even layers. After the long stalks are gathered, the hemp fibers must be removed. To free the fibers, the stalks are either soaked in soft water or hung up in the open, where they are exposed to the weather, especially to the dew. This process is called *retting,* or *rotting.* The water or dew rots the matter around the fiber, so it can be removed easily. Robert A. Barnhardt

Scientific classification. Hemp belongs to the mulberry family, Moraceae. It is *Cannabis sativa.*

See also Abacá; Jute; Marijuana (picture); Philippines (picture); Rope; Sisal.

Hen. See Chicken.

Henbane, *HEHN bayn,* is a poisonous herb that is especially fatal to fowls. It is also called *black henbane.* Henbane is native to Europe and Asia, and it also now grows in North America. It grows from 1 to 2 $\frac{1}{2}$ feet (30 to 76 centimeters) high and has sticky, hairy leaves and greenish-yellow flowers veined with purple. A drug made from henbane, called hyoscyamine, is used to dilate the pupils of the eyes. Jerry M. Baskin

Scientific classification. Henbane is in the nightshade family, Solanaceae. It is *Hyoscyamus niger.*

Henday, Anthony, an English fur trader and explorer of the 1700's, was the first white man to visit the Blackfoot Indians in Canada and to report on their customs and habits. He left Hudson Bay in 1754 to travel to the Saskatchewan River. He made important explorations in what is now the province of Alberta. He was born on the Isle of Wight. Barry M. Gough

Henderson, Fletcher (1897-1952), was a bandleader, pianist, and arranger. He was the first jazz artist to introduce the concept of the "big band" divided into brass, reed, and rhythm sections. Henderson's band was prominent from 1924 until 1938 but never achieved the fame critics believe it deserved. It included such jazz stars as Louis Armstrong, Buster Bailey, Coleman Hawkins, and Lester Young. Beginning in 1934, during the "swing era," Henderson gained fame as the writer of many arrangements for the Benny Goodman band.

Henderson was born on Dec. 18, 1897, in Cuthbert, Georgia. He moved to New York City in 1920. Henderson played piano for several singers. Leonard Feather

See also Jazz (The 1920's).

Henderson, Rickey (1958-), has stolen more bases and scored more runs than any other player in major league baseball history. In 1991, he broke Lou Brock's career stolen base record. In 1982, he set the single season record of 130 stolen bases. He has led the American League in stolen bases 12 times, a league record. In 2001, he broke Ty Cobb's record of 2,244 career runs scored and Babe Ruth's record of 2,062 career bases on balls. Also in 2001, he became the 25th player in major league history to get 3,000 career hits.

Henderson is considered perhaps the greatest leadoff man in baseball history because of his base running and his hitting. He holds the major league record for leading off a game with a home run. He has hit more than .300 for six seasons.

Rickey Henley Henderson was born on Dec. 25, 1958, in Chicago. He made his major league debut in 1979 as a left fielder with the Oakland Athletics. In 1984, he was traded to the New York Yankees. In 1989, the Yankees traded him back to Oakland. In 1993, he was traded to the Toronto Blue Jays. Henderson became a free agent in 1993 and resigned with Oakland. After the 1995 season, he signed with the San Diego Padres. The Padres traded Henderson to the Anaheim Angels in 1997. He returned to Oakland for the 1998 season. He signed with the New York Mets for the 1999 season. The Mets released Henderson during the 2000 season, and he joined the Seattle Mariners. In 2001, Henderson signed to play with the Padres. Donald Honig

Hendricks, Thomas Andrews (1819-1885), was vice president of the United States in 1885 under President Grover Cleveland. Hendricks served as vice president for only eight months before he died in office. He had sought the Democratic presidential nomination in 1868, 1876, 1880, and 1884. Although not a nominee in 1872, he received 42 electoral votes in that election because Horace Greeley, the Democratic nominee, died before the Electoral College met.

Hendricks was the unsuccessful Democratic nominee for vice president in 1876 before winning with Cleveland in 1884. He served in the U.S. House of Representatives from 1851 to 1855 and in the U.S. Senate from 1863 to 1869. He was elected governor of Indiana in 1872.

He was born on Sept. 7, 1819, near Zanesville, Ohio. He served in the Indiana legislature. He was called a Greenback Democrat because he favored issuing more *greenbacks* (paper money). Edward A. Lukes-Lukaszewski

See also Vice President of the United States (picture).

Hendrix, Jimi (1942-1970), was an American rock music guitarist. He extended the range of the electric guitar chiefly by experimenting with the guitar's electronic elements to create sounds that were new to rock. His music emphasized loud volume, a strong beat, and long solo passages that achieved great emotional impact.

Joel Axelrad, Retna Ltd.

Jimi Hendrix

James Marshall Hendrix was born on Nov. 27, 1942, in Seattle. He moved to New York City in the 1960's and formed his own band. In 1966, Hendrix went to England and organized a new band called the Jimi Hendrix Experience. He gained international fame and continued to perform in Europe and the United States. Hendrix died at age 27 of complications from a drug overdose. Don McLeese

Henequen, *HEHN uh kihn,* is a yellow fiber made from leaves of the henequen plant. The plant is native to the Yucatán Peninsula in Mexico, and it is related to the century plant. Its shiny-tipped leaves grow from a trunk

and are sometimes 7½ feet (2.3 meters) long and 4 inches (10 centimeters) wide. Bundles of tough fibers run through the leaves. Machines separate the henequen fibers from the softer portions. The fibers are then dried. Henequen fibers are rough and stiff and are used to make twine.

Scientific classification. The henequen plant belongs to the agave family, Agavaceae. It is classified as *Agave fourcroydes.*

Robert A. Barnhardt

See also **Yucatán Peninsula.**

Henna, *HEHN uh,* is an orange-red dye that varies in color with the article on which it is used. It comes from the leaves of a small shrub that grows in Arabia, Iran, the East Indies, and North Africa. The shrub is also known as *Egyptian privet* and *Jamaica mignonette.* The henna plant is also raised for its fragrant blossoms. Women in Asia use henna to color their nails, fingertips, and parts of their feet. It has been used to dye men's beards, as well as the manes and hoofs of horses. People have also colored wool, silk, and animal skins with henna. Henna is used in the United States as a hair dye.

Scientific classification. Henna is in the loosestrife family, Lythraceae. It is *Lawsonia inermis.* Howard L. Needles

Hennepin, Louis, *HEHN uh pihn* (1626?-1705?), was a Belgian missionary and explorer who became famous for his journey to the Mississippi River Valley in North America. He accompanied the French explorer Sieur de La Salle across the Great Lakes and then explored the upper part of the Mississippi River.

Hennepin was born in Ath, in what is now Belgium. He joined the Franciscans, a Roman Catholic order. In 1675, King Louis XIV of France sent him to what is now Canada, where France had established a colony. In 1676, Hennepin went to Fort Frontenac, on the site of the present city of Kingston, Ontario. There, he founded a mission among Iroquois Indians.

In 1679, Hennepin set out with La Salle's expedition near Niagara Falls. The explorers crossed Lakes Erie, Huron, and Michigan in the *Griffon,* the first ship to sail these waters. The expedition in time reached the Illinois River and constructed Fort Crèvecoeur (Fort Heartbreak) near present-day Peoria, Illinois. The fort was the first European settlement in what is now Illinois.

Early in 1680, Hennepin and two associates explored the upper Mississippi River Valley. Sioux Indians captured them and held them for months. During this time, Hennepin saw and named the Falls of St. Anthony, later the site of Minneapolis, Minn. He returned to Canada in the spring of 1681 and then sailed to France.

During the 1690's, Hennepin wrote two books in which he took credit for being the first European to track the Mississippi River to its mouth at the Gulf of Mexico. He said he reached the gulf before being captured by the Indians. But historians credit La Salle as the first to track the river to the gulf. J. E. Rea

Henri, *HEHN ry* or *HEHN ree,* **Robert** (1865-1929), was an American painter and art teacher. He taught his students to record life directly and spontaneously, an approach that clashed with the "art for art's sake" doctrine popular around 1900.

Henri became the guiding spirit of *The Eight,* an informal association of painters formed in 1907. The painters specialized in realistic scenes from everyday life, but differed considerably in style and often in subject matter. Henri's own work moved from a bright impressionism style in the 1890's to darker tones and gritty urban subjects in the early 1900's. The group was scorned as the *Revolutionary Black Gang,* the *Apostles of Ugliness,* and finally the *Ashcan School.* See **Ashcan School.**

Henri was born Robert Henry Cozad in Cincinnati. He taught in New York City from 1903 to his death. His book *The Art Spirit* (1923) is a valuable guide to his thoughts on art. Charles C. Eldredge

Henry is the unit used to measure *inductance,* the reaction of an electric current against the magnetic field that surrounds it. If the flow of current in a circuit changes or alternates, the magnetic field around the circuit also changes. This changing magnetic field *induces* (creates) a voltage in the circuit that opposes any additional increase or decrease in the flow of current. A circuit has 1 henry of inductance if a current change of 1 ampere per second induces an opposing voltage of 1 volt. The henry was named after the American physicist Joseph Henry. Its symbol is H. Gregory Benford

See also **Inductance.**

Henry, of Portugal. See **Henry the Navigator.**

Henry I (1068-1135), a king of England, was the youngest son of William the Conqueror. He succeeded his brother William II in 1100. Henry married Matilda, daughter of Malcolm III of Scotland and his wife, Margaret, a member of the Saxon royal house of England. Thus, Henry gained the support of his Saxon subjects and strengthened his descendants' claim to the throne.

Henry promoted centralized rule and gave the royal courts greater authority. He seized Normandy from his eldest brother, Robert, in 1106 and later prevented Robert's son, William, from taking control of what had been his father's lands. After his own son's tragic death by shipwreck, Henry arranged for his daughter, Matilda, to succeed him. But when Henry died, his nephew Stephen became king. Emily Zack Tabuteau

Henry II (1133-1189) was the first king of England to come from the Plantagenet family. He reigned from 1154 until his death. Henry carried on policies started by his grandfather Henry I that increased the power of the English throne. Known as the founder of the English system of common law, Henry II revived the use of traveling circuit judges to apply the law equally throughout the land. He also introduced the use of juries into many legal procedures.

Henry was born in Le Mans, France. He was the son of Geoffrey Plantagenet, Count of Anjou, and his wife, Matilda, daughter of Henry I. His marriage in 1152 to Eleanor of Aquitaine made him Duke of Aquitaine. He became king of England in 1154 when King Stephen died. At the height of his power, Henry ruled England and almost all of what is now western France. He also claimed authority over Ireland, Scotland, and Wales. In Henry's later years, his sons rebelled against him. Two of them, Richard the Lion-Hearted and John, became the next two kings of England.

Several of Henry's policies, including his efforts to curb the independence of the church, brought him into conflict with Thomas Becket, archbishop of Canterbury. In 1170, four of Henry's knights, who believed they were acting on the king's orders, murdered Becket in his cathedral. Emily Zack Tabuteau

See also **Becket, Saint Thomas; Eleanor of Aquitaine.**

Henry II (1519-1559) was a king of France. He inherited the throne from his father, Francis I, in 1547. Henry continued his father's policy of persecuting the *Huguenots* (French Protestants). Henry outlawed the Huguenots' religious practices and took their lands. These actions led to bitterness that contributed to the outbreak of religious wars in France after Henry's death.

In 1550, Henry negotiated a treaty with Protestant German princes. The treaty confirmed France's possession of three strategic towns—Metz, Toul, and Verdun—in what is now northeastern France. In 1558, Henry's forces captured the city of Calais, England's last possession in France after the Hundred Years' War (1337-1453).

Henry was born on May 31, 1519, in Saint-Germain-en-Laye, France. In 1533, he married Catherine de Médicis, who was both a niece of Pope Clement VII and a member of the famous Medici family of Florence, Italy. Three of the couple's sons—Francis II, Charles IX, and Henry III—later became kings of France. Henry II and his sons belonged to the Valois family of French kings.

Donald A. Bailey

See also **Catherine de Médicis; Huguenots.**

Henry III (1207-1272) was a king of England. He was only 9 years old when he succeeded his father, King John, in 1216. During Henry's childhood, a group of barons governed. Henry began his personal rule in 1227.

As king, Henry enraged English barons by favoring foreign advisers, waging war unsuccessfully in France and Wales, planning to conquer Sicily, and accumulating large debts. In 1258, the barons forced Henry to accept the Provisions of Oxford, which limited the king's power by putting a council of barons in control of the government. Henry and his supporters struggled for control of the government with the barons, who were led by Simon de Montfort. In 1264, civil war broke out between the two sides.

Simon defeated the king's forces at Lewes in 1264 and took Henry and Henry's son Edward prisoner. In May 1265, Edward escaped. In August, he led the king's supporters to victory over Simon at the Battle of Evesham, at which Simon was killed. Henry regained power and served until his death. Henry was born on Oct. 1, 1207, in Winchester. Emily Zack Tabuteau

Henry III (1551-1589) was the last Valois king of France. He succeeded his brother Charles IX in 1574. Henry had received the Polish crown earlier the same year, but he left Poland when he heard of Charles's death. Henry was a weak king. During the early part of his reign, his mother, Catherine de Médicis, held great influence over him. Influence then passed to Henry's favorites among the young nobles.

Throughout his reign, Henry was caught in the struggle between Roman Catholics and the French Protestants called Huguenots. This struggle included warfare between the two groups. Henry and his mother hoped to end the fighting by signing the Edict of Beaulieu in 1576. The edict gave Huguenots greater freedom of worship. But it turned many Catholics against Henry and led to the War of the Three Henrys (1585-1589). In this war, the real contest was between the Catholic leader, Henry, Duke of Guise, and the Huguenot leader, Henry, King of Navarre. Henry III, who feared the Duke of Guise, had him assassinated in 1588. The next year, Henry himself was assassinated, by a religious fanatic. Henry III was born on Sept. 19, 1551, in Fontainebleau, France.

Donald A. Bailey

Henry III (1017-1056) was king of Germany and emperor of what later became known as the Holy Roman Empire. He ruled Germany as joint king with his father, Conrad II, from 1028 to 1039, when Henry became sole king. Henry was crowned emperor in 1046. His reign was at times troubled by civil wars and by rebellions among the nobles. However, Henry won these conflicts and maintained royal authority over the nobles. He also won border wars in the north and east and extended the empire's eastern boundary to Hungary.

Henry was deeply religious and a lover of peace and justice. He relied heavily on the church for governmental and military support. He backed a movement for church reform—especially the reform of the papacy—by appointing a series of progressive popes, beginning in 1046 with Pope Clement II. Henry was born on Oct. 28, 1017, in Pfalz Bofeld, Saxony. Jonathan W. Zophy

Henry IV (1367-1413) was the first king of England of the House of Lancaster. He became king in 1399, after he forced his rash cousin, King Richard II, from the throne. Many people questioned Henry's claim to the crown. However, Parliament supported him as king and established the Lancastrian dynasty in England.

Revolts and conspiracies in England and Wales marred Henry's reign, but he put them down with great effort and with Parliament's support. Hampered by illness in his later years, he allowed his son Henry, who would succeed him as King Henry V, to play a major role in government affairs.

Henry IV was the son of John of Gaunt, Duke of Lancaster. He was often called Henry of Bolingbroke because he was born at his father's castle of Bolingbroke, in Lincolnshire. He was born on April 3, 1367, and died on March 20, 1413. Ralph A. Griffiths

Henry IV (1553-1610) was the first king of France of the Bourbon dynasty. He succeeded the last Valois king, Henry III, in 1589. Before becoming France's king, Henry IV was known as Henry of Navarre. He had been king of Navarre and a leader of the *Huguenot* (French Protestant) forces in a series of civil wars between the Huguenots and French Roman Catholics. The son of a Huguenot mother and a Catholic father, Henry switched religions for political reasons six times during his life. As king of France, he initially faced opposition from the country's Roman Catholic majority. But after his readmittance to the Catholic Church in 1593, he gradually won his subjects' allegiance. He went on to become one of France's most admired kings.

During the civil wars, Spain interfered in French affairs. It also plotted with Henry's French rivals to overthrow him. Supported by the English and Dutch, Henry was able to make peace with King Philip II of Spain in 1598.

Also in 1598, Henry issued the Edict of Nantes, the first long-lasting edict of religious toleration in modern Europe. The edict granted the Huguenots many privileges and marked the end of France's civil wars.

Henry was born Dec. 13, 1553, in Pau, France, to Antoine de Bourbon and Jeanne d'Albret, queen of Navarre. In 1572, he married Marguerite de Valois, sister of Henry III. The couple had no children and divorced in 1599. In 1600, Henry married Marie de Médicis of the

famous Medici family of Florence, Italy. One of the couple's sons succeeded Henry as King Louis XIII. Henry was assassinated by a religious fanatic. Donald A. Bailey

See also **Bourbon; France (History); Huguenots; Marie de Médicis; Nantes, Edict of.**

Henry IV (1050-1106) became king of Germany in 1056 and Holy Roman emperor in 1084. Henry was only 6 years old when he succeeded his father, Henry III, as Germany's king. The boy's mother ruled for him until he was old enough to take the throne. The nobles revolted during her rule. When Henry took control of the kingdom in 1065, he tried to establish his authority throughout Germany. However, he came into conflict with Pope Gregory VII. In 1075, Gregory forbade *lay investiture*—that is, he denied civil rulers the authority to make appointments to church offices. In response, Henry called a council that met at Worms in 1076 and declared the pope deposed. Gregory in turn expelled Henry from the church and released Henry's subjects from allegiance to him.

Many German princes supported the pope, and so Henry had to yield. Pope Gregory had retired to a stronghold at Canossa in the Apennines. It is said that Henry had to stand barefoot in the snow for three days before he was permitted to kneel at the pope's feet and be pardoned. But after his return to Germany, Henry renewed the struggle. For years, his country was torn by civil war. In 1080, Gregory again excommunicated Henry and deposed him. Henry later captured Rome, and in 1084 he replaced Gregory with a pope of his own choice. That year, Henry was crowned Holy Roman emperor. Gregory died in exile soon after he was replaced as pope, but his successors took up the contest. One of them again expelled Henry from the church. Finally, in 1105, Henry was forced to abdicate after one of his sons rebelled against him. Henry died preparing for war.

Henry IV was born in Goslar, Germany. His son, Henry V, succeeded him. Jonathan W. Zophy

See also **Gregory VII, Saint.**

Henry V (1387-1422) of England became king in 1413. He was the eldest son of Henry IV, of the House of Lancaster. Stern and ambitious, Henry V was known for his sense of justice and for his military leadership.

Henry renewed the Hundred Years' War with France, which had begun in 1337 during the reign of Edward III. He was determined to make good Edward's claim to the French throne. In 1415, Henry won one of the most famous victories in English history when his small army crushed a large French force at Agincourt (see **Agincourt, Battle of**). In 1420, following his conquest of Normandy, Henry married the daughter of Charles VI, king of France. He also forced Charles to declare him heir to the French crown.

Oil painting on wood by an unknown artist; National Portrait Gallery, London

Henry V

Before he died on Aug. 31, 1422, Henry had won the entire northern half of France, with help from the French Duke of Burgundy. But Henry's son and successor, Henry VI, failed in the huge task of preserving Henry's gains in France. This failure helped lead to the overthrow of Henry VI and the House of Lancaster in 1461.

Henry V was born in 1387 in Monmouth, Wales, probably on August 9. He served his military apprenticeship in Wales, suppressing rebellion against his father. Henry appears as Prince Hal in William Shakespeare's *Henry IV,* Parts I and II, and as king in the sequel, *Henry V.* Ralph A. Griffiths

Henry VI (1421-1471) was the last English king of the House of Lancaster. He succeeded his father, Henry V, in 1422, when he was less than a year old. Henry VI also was heir to Charles VI of France, who died the same year Henry became king of England. But the French disputed Henry's claim to the French throne, and so England never controlled all of France in Henry's reign. Henry was pious, educated, and gentle, but he was a weak ruler and had occasional attacks of insanity.

Henry was born Dec. 6, 1421, in Windsor, near London. The English nobles dominated him throughout his life. The country became politically unstable as the nobles took advantage of Henry's weakness to further their own interests. In France, the great conquests of Henry V were gradually lost. By the end of 1453, the French had taken back all the land they had previously held except Calais.

During the 1450's, supporters of the House of York challenged Henry and the House of Lancaster (see **York**). In 1461, the Yorkists forced Henry from the throne and made Edward IV king. Henry regained the crown in 1470. But in 1471, Edward captured Henry and won the battles of Barnet and Tewkesbury. Edward imprisoned Henry in the Tower of London, where he soon died. Edward probably had Henry murdered. Ralph A. Griffiths

See also **Wars of the Roses.**

Henry VI (1165-1197), succeeded his father, Frederick I (also called Barbarossa), as king of Germany in 1190. The next year, Henry was crowned emperor of what later became known as the Holy Roman Empire. In 1192, Henry became involved in a civil war in Germany. King Richard I (the Lion-Hearted) of England had close ties to one of the groups fighting Henry. A vassal of Henry's captured Richard and handed him over to Henry. By holding Richard hostage, Henry gained control over his opponents in the war. He released Richard in 1194. That same year, Henry seized Sicily to expand his empire. He also hoped to gain control of lands along the eastern coast of the Mediterranean Sea by mounting a crusade. But he was stricken with malaria and died while launching this crusade. Henry was born in Nijmegen, in what is now the Netherlands. Jonathan W. Zophy

Henry VII (1457-1509) was the first king of England of the House of Tudor. He restored peace after 30 years of civil war and strengthened England's position among other nations. Henry was a kinsman of the House of Lancaster. He came to the throne in 1485 after his forces killed King Richard III of the House of York in the Battle of Bosworth Field. This battle ensured a Lancastrian victory in the Wars of the Roses, a struggle between the houses of Lancaster and York over possession of the English throne. To gain the support of Yorkists and to strengthen his claim to the throne, Henry married Elizabeth, daughter of Edward IV, of the House of York.

Oil painting on wood (1505) by M. Sittow; National Portrait Gallery, London

Henry VII

Henry was tough, cold, shrewd, and cautious. He used a variety of methods to keep the nobles under control and to guarantee his security. Unlike previous kings, for example, he often disregarded rank when appointing people to high office. He sought instead such qualities as ability and loyalty. He eliminated pretenders to the throne and survived several revolts and conspiracies. See Warbeck, Perkin.

Henry VII increased England's influence in Europe by making important alliances. He arranged a marriage between his son Arthur and Catherine of Aragon, daughter of Ferdinand and Isabella of Spain. After Arthur died, the king secured the young widow, and her dowry, for his younger son, Henry (later King Henry VIII). He also negotiated a marriage between his daughter Margaret and James IV of Scotland. Henry kept England out of European wars and accumulated a large fortune. He was born in Pembroke, Wales. Ralph A. Griffiths

See also **Tudor, House of; Wars of the Roses.**

Henry VIII (1491-1547), a king of England, greatly influenced English history by separating the Church of England from the Roman Catholic Church. Henry is often remembered for his pleasure-seeking life style, his cruelty, and his six wives. However, he was well-educated and a capable ruler.

During his reign, Henry built up a strong fleet of fighting ships. He also presided over a major government reorganization that helped set the stage for England's development into a leading world power. This reorganization included the establishment of a bureaucracy that took over many government duties from the royal household. Henry also involved England in several expensive wars with France and Scotland.

Henry was born in Greenwich, near London. His father, Henry VII, was the first of the Tudor family of English rulers. Henry VIII was 17 years old when he came to the throne in 1509. One of his first acts as king was to marry his brother's widow, Catherine of Aragon. Catherine bore Henry six children, but only one lived—a daughter who later reigned as Mary I. Henry wanted a male heir in order to help ensure that the Tudor family would continue to control the throne and to prevent any fighting over who would succeed him. He turned his attentions to a maid of honor at court, Anne Boleyn. Thomas Cardinal Wolsey, Henry's chief minister, asked Pope Clement VII to *annul* (cancel) the king's marriage. But Wolsey could not get the pope to do so, and Henry dismissed Wolsey in 1529.

Oil painting on canvas (about 1537) by Hans Holbein the Younger; National Gallery, Rome (Royal Academy of the Fine Arts, London)

Henry VIII

The king then denied that the pope had authority over England. He secretly married Anne Boleyn in January 1533. In March of that year, Parliament passed the Act in Restraint of Appeals, which declared that England was independent of all foreign authorities, including the pope, and that the king was England's highest judicial authority. On the basis of that act, a church commission headed by the Archbishop of Canterbury, Thomas Cranmer, declared the marriage of Henry and Catherine to be without legal force. In June 1533, Anne was crowned queen.

At Henry's insistence, Parliament passed additional acts that completed the English church's break with the Roman Catholic Church. In 1534, the Act of Supremacy recognized the Church of England as a separate institution and the king as its supreme head. In the years that followed, Henry dissolved the monasteries in England, primarily to obtain their wealth.

The annulment did not produce a stable married life for Henry. In 1533, Anne bore him a daughter who later reigned as Elizabeth I. Then in 1536, the king had Anne beheaded on a charge of adultery. Henry's third wife, Jane Seymour, died shortly after the birth of a son who later ruled as King Edward VI.

At the urging of his chief minister, Thomas Cromwell, Henry married a German princess, Anne of Cleves. But Cromwell was disgraced and executed, and Henry had his marriage to Anne annulled. The king then married Catherine Howard, who, in 1542, was convicted of adultery and executed. Henry's sixth and last wife, Catherine Parr, outlived him. Richard L. Greaves

Related articles in *World Book* include:

Boleyn, Anne
Catherine of Aragon
Cranmer, Thomas
Cromwell, Thomas
Elizabeth I
England (The English Reformation)
Wolsey, Thomas Cardinal

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Erickson, Carolly. *Great Harry.* 1980. Reprint. St. Martin's, 1997.
Green, Robert. *King Henry VIII.* Watts, 1998. Younger readers.
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Henry, Alexander (1739-1824), won fame as a fur trader in Canada after the United Kingdom gained control of the area from France in the 1760's. He helped open western Canada and the area north of Lake Superior to trade with the British.

Henry was born in New Jersey. He became a trader as a young man and was one of the first traders to reach Mackinac Island in the Straits of Mackinac. The island became the center of the western fur trade. In 1763, an Indian friend saved Henry's life after Indians organized by Pontiac captured Mackinac Island (see **Pontiac**).

In 1781, Henry became a merchant in Montreal and sold his trading interests to the North West Company, a famous fur-trading firm. Henry described his experiences as a fur trader in his book *Travels and Adventures in Canada and the Indian Territories between the Years 1760 and 1776* (1809). Hartwell Bowsfield

Henry, John, an African-American laborer, is a hero in American folklore. He is the subject of perhaps the most famous American folk ballad and of many stories and songs.

The original story about John Henry is based on an actual event involving a man of that name. In the early 1870's, laborers were building the Big Bend Tunnel on the Chesapeake and Ohio Railroad in West Virginia. They used long-handled hammers to pound a steel drill into rock when making holes to hold blasting explosives. One day, a man brought an experimental steam drill to the site. He claimed it could dig a hole faster than 20 workers using hammers.

According to the ballad, John Henry raced the steam drill to prove that a man could dig a hole faster than a machine:

> They placed John Henry on the right-hand side,
> The steam drill on the left;
> He said, "Before I let that steam drill beat me down
> I'll die with my hammer in my hand, O Lord,
> And send my soul to rest."

In the ballad, John Henry won the race but died from exhaustion at the moment of his victory. The real John Henry, after beating the steam drill in the race, is said to have been crushed by rock that fell from the ceiling of the tunnel.

The legend of John Henry developed from ballads, songs, and stories about him. He symbolized the workers' fight against being replaced by machines. The earliest known written version of the ballad appeared about 1900. Ellen J. Stekert

Henry, Joseph (1797-1878), an American physicist, became famous for his discoveries in electromagnetism. He anticipated both Samuel F. B. Morse's invention of the telegraph and Michael Faraday's discovery of electromagnetic induction. Henry received no credit for his work at the time, but the unit of electrical inductance is now called the *henry* (see **Henry**).

Henry was born in Albany, New York. He was educated at Albany Academy, where he later taught mathematics and physics. He began experimenting in electromagnetism while teaching there. His first major work was improving the electromagnet, which William Sturgeon had discovered. From 1832 to 1846, Henry was a professor at the College of New Jersey (now Princeton University). He later became the first secretary and director of the Smithsonian Institution. In 1867, he became president of the National Academy of Sciences, which was established in 1863. Richard G. Olson

See also **Electromagnetism; Faraday, Michael; Morse, Samuel Finley Breese.**

Henry, O. (1862-1910), was the pen name of an American story writer, William Sydney Porter. In most of his nearly 300 works of fiction, O. Henry showed his mastery of mechanical plots, which build up to sharp, unexpected endings, as in "The Gift of the Magi" (1905). Most of O. Henry's stories are sentimental rather than psychologically deep. Yet his sympathy for human weaknesses and the naturalness of his characters make his stories appealing. O. Henry wrote in the language of the common people.

His works. O. Henry published about 16 volumes of stories, reflecting his own colorful experiences and those of his associates. The models of some of his best-known characters were criminals and soldiers of fortune, whom he met in Central America and later in New York. His stories usually tell about victims of coincidence or fate. An example is "The Furnished Room" (1904). In this story, a lover seeks his sweetheart, who came to New York for a singing career. He rents a room where he commits suicide after being unable to find the girl. The lover never learns that his sweetheart had earlier killed herself in that same room. *The Voice of the City* (1908) deals with the loneliness and tragic predicaments of innocent country folk who come to the impersonal city to seek their fortune.

O. Henry's other works include *Cabbages and Kings* (1904), *The Four Million* (1906), *The Trimmed Lamp* (1907), *Heart of the West* (1907), *The Gentle Grafter* (1908), *Roads of Destiny* and *Options* (1909), *Strictly Business* and *Whirligigs* (1910), *Sixes and Sevens* (1911), and *Waifs and Strays* (1917). *The Complete Works of O. Henry* was published in 14 volumes in 1917.

His life. William Sydney Porter was born in Greensboro, North Carolina. He left school when he was 16 and worked in his uncle's drugstore. Then he went to Texas and worked for two years on a ranch. Later he moved to Austin, Texas, where he was a bank clerk for a while. He began to write short sketches, some of which appeared in the *Detroit Free Press.* In 1894, he bought a paper called the *Iconoclast,* and renamed it *The Rolling Stone.* A year later, he moved to Houston, where he wrote for a newspaper.

In 1896, Porter was called back to Austin to stand trial on a charge of stealing funds from the bank. Although he might have been pardoned, he fled to Honduras. When he returned to Austin to the deathbed of his wife, he was arrested and imprisoned for three years. Using various pen names, he wrote and published several short stories while he was in prison. After he was released, he went to New York City, where he worked first as a newspaper columnist and then a short-story writer.

Bert Hitchcock

See also **Short story.**

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Henry, Patrick (1736-1799), was a distinguished statesman, lawyer, and orator at the time of the Revolutionary War in America. He is remembered most for the words, "Give me liberty or give me death," which, according to tradition, he spoke in 1775 before the Virginia Provincial Convention. Henry was urging that the Virginia militia be armed for defense of the colony against England. A man who heard many of Henry's speeches once said of the orator: "He is by far the most powerful speaker I ever heard. Every word he says not only engages but commands the attention." Henry was also an excellent politician and administrator. Henry served as the governor of Virginia during the Revolutionary War.

Early life. Henry was born in Hanover County, Virginia. He attended public school for only a short time, but was taught by his father, who had a good education. As a young man, Henry was a storekeeper for a time. But he was a poor businessman and, as a result, he was soon hopelessly in debt. He then studied law and received his license to practice in 1760. Three years later,

Henry's talent as an orator won him fame in Virginia in a noted lawsuit called the Parson's Cause.

In 1764, Henry was elected to the Virginia House of Burgesses. He soon became a leader, supporting frontier interests against the old aristocracy. He upheld the rights which the colonies were guaranteed by their charters. His speech against the Stamp Act in 1765 is one of his greatest orations (see **Stamp Act**). In it, according to tradition, appear the often-quoted words: "Caesar had his Brutus—Charles the First, his Cromwell—and George the Third—*may profit by their example.* If *this* be treason, make the most of it."

In August 1774, the colony of Virginia elected Henry a delegate to the First Continental Congress (see **Continental Congress**). He was also a member of the Second Continental Congress for a short time in 1775. After that, he became commander in chief of Virginia's military forces. He resigned this post in February 1776. A few months later, he was chosen a member of the committee to draw up the first constitution of the commonwealth of Virginia.

Career as governor. Henry became governor of the new commonwealth of Virginia as soon as it was established in 1776. He moved into the palace at Williamsburg, where the English colonial governors had lived. He was a hard-working administrator. Henry showed his feeling of democracy when he became the first American politician to refer to the voters as "fellow citizens."

The Revolutionary War brought many problems to Virginia, and Henry worked hard to solve them. He recruited the state's quota of about 6,000 men for the Continental Army, plus the state militia of nearly 5,000 soldiers. The state supplied its soldiers with clothing and shoes, and sent cattle to feed the men at Valley Forge. Henry encouraged mining lead to provide ammunition, and imported and manufactured gunpowder. He set up shipyards and dockyards to protect the Virginia coast, and he arranged for loans.

Henry was criticized in spite of his hard work, especially when the forces under the British General Banastre Tarleton overran Virginia. But he was elected governor again in 1777, 1778, 1784, and 1785. During his second term, Henry provided supplies for the George Rogers Clark expedition, which conquered the Northwest Territory (see **Northwest Territory**).

Detail of *Patrick Henry Before the Virginia House of Burgesses* (1851), an oil painting on canvas by Peter Frederick Rothermel (Patrick Henry Memorial Foundation)

Patrick Henry lashed out at English tyranny in a great speech before the Virginia House of Burgesses in 1765.

Henry's famous speech

Patrick Henry delivered his best-known speech before the Virginia Provincial Convention on March 23, 1775. No written records of the speech exist. The speech was printed in an early biography of Henry by William Wirt, who relied chiefly on accounts given to him by people who heard the speech. The conclusion of the speech follows:

"Three millions of people, armed in the holy cause of liberty, and in such a country as that which we possess, are invincible by any force which our enemy can send against us. Besides, sir, we shall not fight our battles alone. There is a just God who presides over the destinies of nations, and who will raise up friends to fight our battles for us. The battle, sir, is not to the strong alone; it is to the vigilant, the active, the brave.

"Besides, sir, we have no election. If we were base enough to desire it, it is now too late to retire from the contest. There is no retreat, but in submission and slavery. Our chains are forged. Their clanking may be heard on the plains of Boston! The war is inevitable—and let it come! I repeat it, sir, let it come!

"It is in vain, sir, to extenuate the matter. Gentlemen may cry, peace, peace—but there is no peace. The war is actually begun! The next gale that sweeps from the north will bring to our ears the clash of resounding arms! Our brethren are already in the field! Why stand we here idle? What is it that gentlemen wish? What would they have? Is life so dear, or peace so sweet, as to be purchased at the price of chains and slavery? Forbid it, Almighty God! I know not what course others may take; but as for me, give me liberty, or give me death!"

In 1788, Henry served in the Virginia state convention, that was called to ratify the United States Constitution. He opposed ratification because he believed that the Constitution endangered the rights of individuals and states. After he lost, however, he accepted the Constitution and joined the Federalist Party. Henry was largely responsible for the adoption of the first 10 amendments to the Constitution, known as the Bill of Rights (see **Bill of rights**).

Return to private life. Public service left Henry badly in debt, and in 1788 he returned to his law practice. His fame as a brilliant speaker gained him many clients, and he soon became a successful criminal lawyer. His law fees helped him to buy land, and in 1794, he retired to his Red Hill estate, near Appomattox, Va.

During the next five years, Henry refused many requests to return to public life. He was offered a seat in the U.S. Senate, posts as minister to Spain and to France, a place in George Washington's Cabinet as Secretary of State, and the position of Chief Justice of the United States. In 1796, Henry was elected governor of Virginia for the sixth time, but he refused the office.

Finally George Washington persuaded him to become a candidate for representative in the Virginia state legislature. Henry made his last great speech during this campaign. The speech was a denial of a state's right to decide the constitutionality of federal laws. Henry told

the voters: "United we stand, divided we fall. Let us not split into factions which must destroy that union upon which our existence hangs." Henry won the election, but he died before he could take office. Henry was buried at Red Hill. William Morgan Fowler, Jr.

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Henry of Navarre. See Henry IV (of France).

Henry the Navigator (1394-1460) was a Portuguese prince who promoted explorations of the west African coast during the 1400's. These explorations helped advance the study of geography and made Portugal a leader in navigation among European nations of that time. Henry sent out more than 50 expeditions but went on none of these voyages himself.

Henry was the son of King John I and Queen Philippa. He was a serious, studious youth, and he had a special interest in mathematics and astronomy. Henry and two older brothers, Duarte and Pedro, wanted to prove that they were worthy to be knighted. With their father's approval, they organized an army and captured Ceuta, an important commercial town in Morocco. The three brothers were knighted, and Henry was appointed governor of Ceuta.

The commercial routes between Ceuta and inner Africa stirred Henry's interest in the geography of Africa. Henry wanted to expand Portugal's trade and influence along the African coast. He also hoped to find the source of the gold that Islamic traders had been carrying north from central Africa for hundreds of years. Henry's skill in mathematics and astronomy helped him organize expeditions along the northwest African coast. In 1419, two Portuguese explorers sent by Henry reached Porto Santo, one of the Madeira Islands. These explorers, João Gonçalves and Tristão Vaz, sailed to the island of Madeira itself in the early 1420's. Portugal colonized both islands.

One of Henry's goals was to send explorers beyond Cape Bojador, in what is now Western Sahara. The cape was the southernmost point known to Europeans at that time. After several unsuccessful attempts, an expedition led by Gil Eanes finally passed the cape in 1434. Eanes reached Rio de Oro, also in Western Sahara, in 1436.

One of Henry's explorers, Antão Gonçalves, returned to Portugal with some Africans he had captured on an expedition in 1441. These people were the first slaves brought from west Africa to Europe. One of the captives was a chieftain named Adahu, who told Henry about lands farther south and inland. In 1441, Nuño Tristão sailed as far south as Cape Blanc, on the border of Western Sahara and Mauritania. Diniz Diaz reached Cape Verde, in present-day Senegal, in 1445. By the time of Henry's death in 1460, Portuguese ships had reached the coast of Sierra Leone.

Henry planned and raised the money for the expeditions. He was aided by mapmakers, astronomers, and mathematicians of many nationalities, whom he gathered together at Sagres, near Cape St. Vincent, Portugal. The navigational knowledge gained under Henry's direction led to several historic voyages within 50 years after his death. They included the voyages of the Portuguese explorers Vasco da Gama and Bartolomeu Dias around the southern tip of Africa. John Parker

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Henson, Jim (1936-1990), an American puppeteer, created the Muppets, a combination of marionettes and foam-rubber hand puppets. The Muppets gained international popularity with children and adults through TV and movies. The best-known Muppets include Kermit the Frog, Miss Piggy, Oscar the Grouch, and The Cookie Monster. Henson was the manipulator and voice of several Muppets, including Kermit.

James Maury Henson was born in Greenville, Mississippi. He created the Muppets in 1954. They first appeared in 1955 on a local Washington, D.C., TV program called "Sam and Friends." During the 1960's, Henson and his company of puppeteers appeared as guests on national TV shows. In 1969, the Muppets first appeared on the educational public TV show "Sesame Street." From 1976 to 1981, Henson produced "The Muppet Show," which became the most widely seen TV program in the world. The Muppets starred in *The Muppet Movie* (1979) and other motion pictures. Don B. Wilmeth

Henson, Matthew Alexander (1866-1955), was an African American explorer of the Arctic. The expedition of Henson and Robert E. Peary is generally credited with discovering the North Pole in 1909.

Bettmann Archive

Matthew A. Henson

Henson was born on a small farm in Charles County, Maryland. At the age of 12 or 13, he became a cabin boy on a merchant ship. When he was 18, he put ashore and began working at various jobs on the East Coast.

In 1887, Peary hired Henson to help him survey a canal route across Nicaragua. From 1891 to 1906, Henson and Peary were partners on several Arctic expeditions but failed to reach the North Pole. In 1908, they began another attempt. The expedition included several support teams, but when the party neared the pole, Peary chose the experienced Henson and four Inuit to make the final dash. Some historians believe that Henson and two Inuit were the first to reach the pole. But Peary said that Henson miscalculated the location of the pole and that he—Peary—was actually the first to reach it. Peary received credit for the discovery.

During his lifetime, Henson received little recognition for his achievements. He died in obscurity. In 1988, however, Henson's remains were moved to Arlington National Cemetery and reburied with full military honors. Henson now lies next to Peary, honored as co-discoverer of the North Pole. William R. Hunt

See also Peary, Robert Edwin.

Henze, *HEHN tsuh,* **Hans Werner,** *hahns VEHR nuhr* (1926-), is a German composer. His works incorpo-

rate modern atonality with more traditional musical forms. Often dissonant and angular, Henze's music is also considered highly expressive and colorful. Henze's radical political views, as well as his bold musical ideas, have made him controversial. His most famous works are operas. They include *Boulevard Solitude* (1952), *Elegy for Young Lovers* (1961), and *Der Junge Lord (The Young Lord,* 1965). Henze is also known for his music for ballets. In addition, he has written piano concertos, symphonies, choral works, chamber music, and theater pieces with revolutionary political themes. The latter include *El Cimarrón* (1970) and *La Cubana* (1973). Henze's essays have been collected in *Music and Politics* (1982).

Henze was born in Gütersloh. His early works show the influence of the composers Arnold Schoenberg and Igor Stravinsky. Stephen Jaffe

Hepatica, *hih PAT uh kuh,* is the name of a group of sturdy but dainty woodland plants of the Northern Hemisphere. They are related to anemones. The name *hepatica* comes from a Greek word that means *liver.* A hepatica's dark green, leathery leaves have three scallops, or *lobes,* and are shaped like livers. The plant is often called *liverleaf* or *liverwort.* Six petallike sepals form a hepatica's buttercup-shaped flowers. Each year, the flowers appear before the new green leaves do.

Hepaticas have pink, white, or lavender blossoms that appear in abundance during early spring. Each flower grows on a stem 3 to 6 inches (8 to 15 centimeters) high. The leaves may have rounded or pointed lobes, depending on the species. Melinda F. Denton

Scientific classification. Hepaticas belong to the crowfoot family, Ranunculaceae. Those with rounded lobes are *Hepatica americana.* The pointed-lobed plant is *H. acutiloba.*

Hepatitis, *HEHP uh TY tihs,* is a disease characterized by inflammation of and injury to the liver. Hepatitis has many causes, including misuse of alcohol and drugs, but viruses are the most common cause. Researchers estimate that more than 300,000 cases of viral hepatitis occur each year in the United States.

Symptoms of viral hepatitis appear from two weeks to six months after exposure to the virus. The first symptoms are usually fatigue, poor appetite, and nausea. Pain in the abdomen above the liver and a slight fever are also common. After a few days, the person's urine becomes dark, and *jaundice* (a yellowish discoloration of the skin) appears. The jaundice and dark urine indicate the liver is not working properly in removing a reddish-yellow pigment called *bilirubin* from the blood.

Symptoms of viral hepatitis generally last two to six weeks. Severe cases can lead to liver failure and death. But most patients—even those with severe hepatitis—eventually recover completely. In some patients, the disease becomes persistent and is called *chronic hepatitis.* People with chronic hepatitis may experience mild, vague symptoms of fatigue and poor appetite. Chronic hepatitis can lead to a liver disease called *cirrhosis,* and it is also a major cause of liver cancer.

There are five types of viral hepatitis: (1) hepatitis A, (2) hepatitis B, (3) hepatitis C, (4) hepatitis D, and (5) hepatitis E. Hepatitis types A, C, D, and E are caused by viruses that have a core of *ribonucleic acid* (RNA). The hepatitis B virus has a *deoxyribonucleic acid* (DNA) core.

Hepatitis A is a highly contagious disease, but it is rarely fatal. It is also called *infectious hepatitis.* Hepatitis A is extremely common in less developed countries. Outbreaks often occur due to unsanitary conditions, such as contamination of food or the water supply. The serum *gamma globulin* can prevent hepatitis A if given before or soon after exposure to the virus. A vaccine that prevents hepatitis A is available. It is recommended for high-risk groups, including international travelers and some military personnel.

Hepatitis B is the best-known form of viral hepatitis. It can be severe and often develops into chronic hepatitis and cirrhosis. Hepatitis B is spread by close personal or sexual contact with an infected person, or by exposure to infected blood. It once was commonly transmitted through transfusions of contaminated blood. However, tests that detect the virus in blood have largely eliminated this danger. A vaccine that prevents hepatitis B is available, and U.S. public health experts recommend that all children be vaccinated. Doctors use a drug called *alpha interferon* to treat chronic hepatitis B.

Hepatitis C is the most common cause of chronic hepatitis and a major cause of cirrhosis in the United States. Experts think many cases of hepatitis C result from using contaminated needles for injecting illegal drugs, tattooing, or body piercing. Hepatitis C often leads to chronic hepatitis, cirrhosis, liver failure, or liver cancer. Since a blood test to detect this virus became available in 1990, infection is rarely transmitted by blood transfusions. Hepatitis C is usually treated with a combination of a drug called *alpha interferon* and an antiviral drug called *ribavirin.* Some patients receive only interferon.

Hepatitis D is the most serious and also the rarest form of viral hepatitis. It only infects people who also have hepatitis B. Many cases of hepatitis D are fatal, and most chronic cases lead to cirrhosis. Hepatitis D most commonly occurs among intravenous drug users, who can be infected by sharing hypodermic needles.

Hepatitis E often occurs in epidemics that can be linked to poor hygiene and contaminated water. It is particularly likely to lead to serious illness in pregnant women. The disease has been reported almost exclusively in less developed countries. Jay H. Hoofnagle

See also **Jaundice; Gamma globulin; Virus; Liver.**

Hepburn, Katharine (1907-), is an American actress. She became famous for her distinctive voice and her roles as high-spirited, independent upper-class women in such films as *The Philadelphia Story* (1940). Hepburn was nominated for 12 Academy Awards. She won Academy Awards for best actress in *Morning Glory* (1933), *Guess Who's Coming to Dinner* (1967), *The Lion in Winter* (1968), and *On Golden Pond* (1981).

United Press Int.

Katharine Hepburn

Hepburn was born in Hartford, Connecticut. She made her film debut in 1932 in the melodrama *A Bill of Divorcement.* From 1942 to 1967, Hepburn made nine films with actor Spencer Tracy. The most popular of these include *Adam's Rib* (1949) and *Pat and Mike* (1952). She por-

trayed spinsters in *The African Queen* (1951), *Summertime* (1955), and *The Rainmaker* (1956).

Hepburn made about 40 films. She also appeared on the stage in a variety of plays. Louis Giannetti

Hephaestus, *hih FEHS tuhs,* was the blacksmith of the gods in Greek mythology. The Greeks associated him with the creative fire used in blacksmithing and the crafts. They credited him with making marvelous objects and inventions. He also formed the first woman, sometimes called Pandora.

Hephaestus was represented as lame, a projection of his worshipers, because many ancient Greek blacksmiths were lame and thus unfit to serve as warriors, hunters, or farmers. The Greeks associated Hephaestus with volcanic areas, especially the island of Limnos (also spelled Lemnos). He was the son of Hera, goddess of marriage and childbirth. In a number of stories, his father was Zeus, king of the gods. According to some myths, Hephaestus was married to Aphrodite, goddess of love and beauty. In others, he was married to one of the Graces, who were daughters of Zeus. The Roman god Vulcan resembles Hephaestus. F. Carter Philips

See **Pandora; Vulcan.**

Hepplewhite, George (? -1786), was an English furniture maker and designer. No known examples of his furniture exist. Hepplewhite's reputation rests mainly on his book of furniture designs, *The Cabinet-Maker and Upholsterer's Guide* (published in 1788, after his death). It has engravings of nearly 300 designs that Hepplewhite and others made popular between about 1770 and 1790. Furniture based on these designs is called Hepplewhite.

Hepplewhite furniture has graceful contours and features delicate ornamentation with painted *moldings* (wooden strips) and inlays of contrasting woods. Hepplewhite chairs have backs shaped like hearts, ovals, or shields and straight tapered legs.

Little is known about Hepplewhite's life. After 1760, he owned a workshop in London. Nancy E. Richards

See also **Furniture** (English neoclassical furniture).

Heptarchy. See also **Anglo-Saxons; Egbert.**

Heptathlon, *hehp TATH lahn,* is a two-day women's track and field contest that consists of seven events. The same athletes compete in all the events. Events are held in this order: 100-meter hurdles, high jump, shot put, 200-meter dash, long jump, javelin throw, and 800-meter run. The first four events are held the first day and the last three on the second day. Competitors receive points for their performance in each event. The athlete with the highest total number of points wins. For many years, women competed in a five-event contest called the *pentathlon.* In 1981, two events were added and the competition was renamed the heptathlon. Michael Takaha

See also **Track and field** (The decathlon, heptathlon, and pentathlon; table: World track and field records); **Olympic Games** (table: Track and field); **Pentathlon, Modern; Joyner-Kersee, Jackie.**

Hepworth, Barbara (1903-1975), was a leading English sculptor. Her work does not fall into any distinct style. Some of her sculptures are based on human figures. She reduced them to a few basic forms, alone or connected to another figure or to its surroundings. Other sculptures are more abstract, made of smoothly carved wood or marble or bronze casts. Hepworth created these works in angular, circular, or spiral geometric shapes. They are almost always pierced with one or more holes to emphasize the tensions in the hollows.

Sculpture (1963) of wood and strings; Barbara Hepworth Museum, Cornwall, England (Tate Gallery)

A Hepworth sculpture called *Pierced Hemisphere (Telstar)* is made of smoothly carved wood. Like many of Hepworth's other abstract works, the sculpture is circular and pierced with a hole.

Jocelyn Barbara Hepworth was born in Wakefield in West Yorkshire, a part of England with rolling landscapes that she said influenced her work. At the outbreak of World War II in 1939, Hepworth moved to the village of St. Ives in Cornwall with her husband, painter Ben Nicholson. Cornwall's rugged coastline and wild landscape also influenced her work. Hepworth died in a fire in her St. Ives studio. Her sculpture *Single Form* (1963) stands in the United Nations Plaza in New York City. Ann Friedman

Hera, *HIHR uh,* was a goddess of life in Greek mythology. She was especially a protector of marriage and childbirth. Hera was important in the city of Olympia and was the principal goddess of the people of Argos and Samos. Hera was a daughter of Cronus and Rhea and the sister and wife of Zeus, the king of the gods. Her children included the gods Ares and Hephaestus.

Hera and Zeus quarreled regularly. Hera was fiercely hostile to any woman—divine or mortal—who won Zeus's interest. Children of Zeus and his mistresses, notably Hercules and Dionysus, also suffered from her anger. Stories tell how Hera sent the many-eyed monster Argus to watch Zeus's mistress Io. Zeus sent Hermes to kill Argus, who—in Greek versions—turned into a peacock, Hera's special bird. According to the Roman poet Ovid, Hera stripped the dead Argus of his eyes to adorn the peacock's tail. F. Carter Philips

See also **Juno; Io; Hercules; Paris** (in mythology).

Heracles. See **Hercules.**

Heraclitus, *HEHR uh KLY tuhs,* was an early Greek philosopher active about 500 B.C. He regarded himself as having access to a central truth available to all people.

However, people remained ignorant of this truth due to failure to use their senses and understand correctly. This truth is a unifying rational principle called the *logos*. Heraclitus asserted that everything in the world constantly changes and moves, a condition he called *strife* (flux). He believed that this unending motion ties together all opposing forces—such as hot and cold—in a delicate balance or state of tension. This underlying unity has come to be known as the unity of opposites.

Heraclitus thought that the unity and strife that make up the universe also govern human life. This unity appears most obviously in the tension between life and death and waking and sleeping. Heraclitus asserted that the world is a fire, which is a living symbol of the constant strife in the ordered world. The soul is fiery.

Heraclitus lived in Ephesus, a city in Asia Minor (now Turkey). He wrote one book from which about 130 fragments have survived. In ancient times he was known as the *Obscure* because of the difficulty of his thought. See **Pre-Socratic philosophy**. Carl A. Huffman

Herald. In ancient times, direct communication between a ruler and the people was often impossible. The rulers used special officials, called *heralds,* to deliver messages and orders, and to announce decisions and events. In the Middle Ages, heralds became personal agents for the king and enjoyed great honor. It was a crime to interfere with their work or to harm them.

Medieval heralds became authorities on *coats of arms,* the emblems and designs used on the shields and clothing of nobles in battle. They supervised the selection of new designs to prevent duplication and to make sure that people did not claim ancestry to which they were not entitled. Joel T. Rosenthal

See also **Heraldry**.

Heraldry is the study of a system of symbols used to represent individuals, families, countries, and such institutions as churches and universities. The basic heraldic symbol is an emblem called a *coat of arms,* often known simply as *arms*. Coats of arms were originally used on the shields of knights.

Heraldry is related to similar systems of symbolism, such as seals and flags. It also is connected with *genealogy,* the study of family history.

The development of heraldry

Beginnings. The first coats of arms appeared during the early 1100's. They were used by Christian knights from western Europe who fought in a series of military campaigns called the *Crusades*. The Europeans wanted to regain control of Palestine from the Muslims. The knights wore heavy metal armor during battle, and helmets covered their faces. They displayed coats of arms on their shields and flags so their followers could recognize them on the battlefield.

Heraldry also served as a means of identification in civilian life. European societies were governed by a political and military system known as *feudalism*. Under feudalism, landowning nobles gave other nobles possession but not ownership of land in exchange for their military and other services. The upper classes consisted of royalty, nobility, and clergy. Members of these classes identified their possessions and official documents by marking them with their coats of arms. The common people did not have coats of arms.

Expansion. By the 1200's, heraldry had become firmly established as a system of identification. Upper-class families passed their coats of arms down from one generation to the next. By custom, and eventually by heraldic law, no two families could use the same coat of arms. The many heraldic designs, plus the possible confusion among them, led to the development of a group of men who regulated such matters. This class consisted of official messengers called *heralds*.

At first, the heralds carried messages between princes and armies, announced and directed tournaments, and conducted certain ceremonies. The heralds had to know one knight from another to perform their duties, and heraldic symbols provided the necessary identification.

The duties of the heralds increased as heraldry expanded to include more and more families. For example, the heralds became responsible for keeping track of families and their coats of arms. In addition, heralds made books called *armorials,* in which they recorded the designs of coats of arms. They also developed a special language known as *blazonry* for describing the arms. In blazonry, the *dexter side* of a shield is the right side from the wearer's viewpoint, and the *sinister side* is the left side.

The colors and the representations of metals or furs used on a coat of arms are called *tinctures*. They include *argent* (silver or white), *azure* (blue), *gules* (red), *or* (gold), and *sable* (black).

After feudalism. During the 1200's and 1300's, feudalism began to decline in most European nations. At about the same time, armies developed new methods of warfare that did not require the use of coats of arms. However, heraldic symbols remained important in tournaments and in some ceremonies. The emblems served as decorations at such events and showed the importance of those who used them.

Heraldry today. Most nations have abolished heraldry and other social privileges that once belonged to the upper classes. However, some people in such countries as Great Britain and South Africa still use heraldic symbols to show their ancestry. In England, the College of Arms, also known as the Heralds' College, decides who has the right to use a coat of arms. The college, established in 1484 by King Richard III, also chooses the elements that must appear on the emblem.

The governments of many nations, states, provinces, cities, and towns have coats of arms. The use of the emblems by governments is called *civil heraldry*. Some international organizations also have coats of arms.

In the United States, anyone may create and use a coat of arms. Such a self-created emblem is called *arms of assumption*. Many coats of arms for common family names are sold in the United States and Canada, but few are authentic.

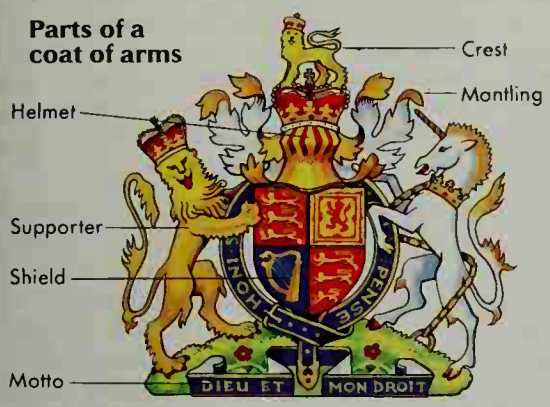
Elements of a coat of arms

By the late 1400's, heralds had established certain rules that affected the design of a coat of arms. These rules later came to be known as the *laws of heraldry*. The rules discussed in this article are those of England.

The basic element of any coat of arms is the *shield,* also known as the *escutcheon*. A coat of arms, sometimes called a *heraldic achievement,* may include certain

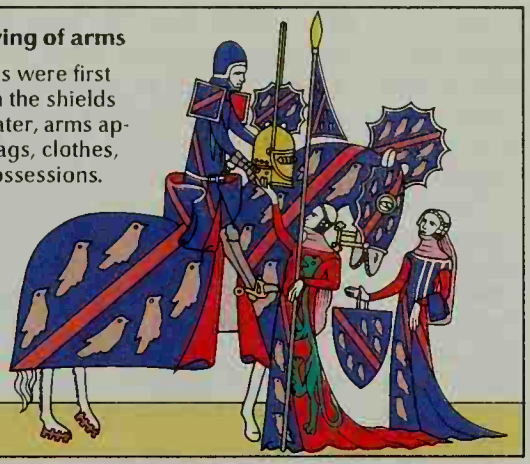
Symbols of heraldry

Parts of a coat of arms



The displaying of arms

Coats of arms were first displayed on the shields of knights. Later, arms appeared on flags, clothes, and other possessions.



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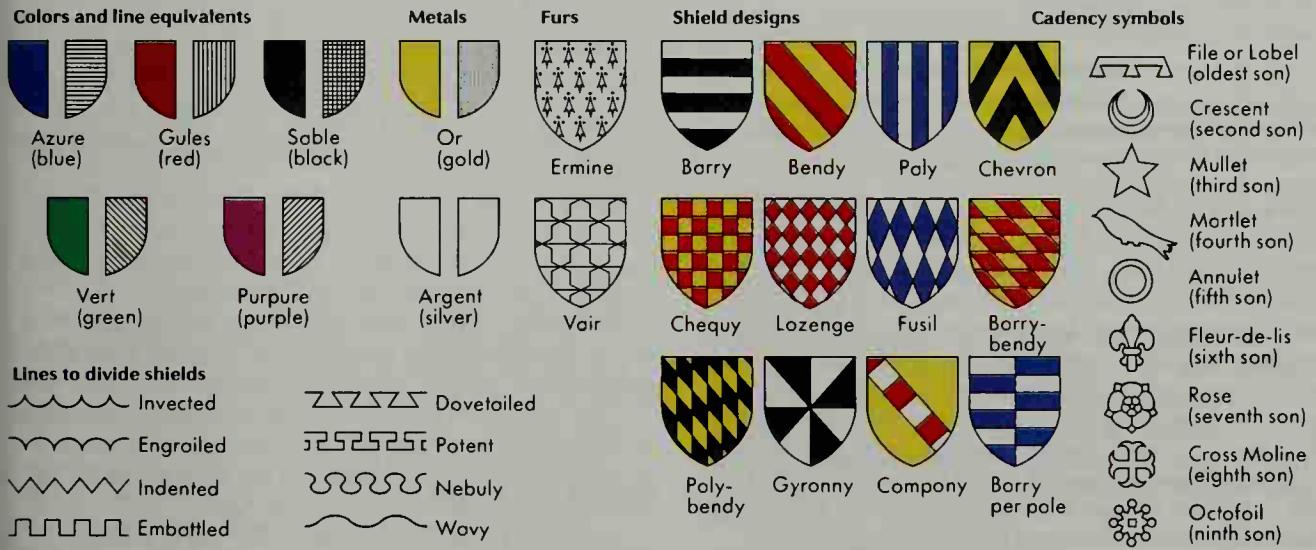
Symbols used on a coat of arms

Coats of arms were developed during the 1100's as a way to help a knight's followers recognize him on the battlefield. The colors, designs, lines, and *cadency* (status) symbols shown below became standard and were used in different combinations according to specific rules.

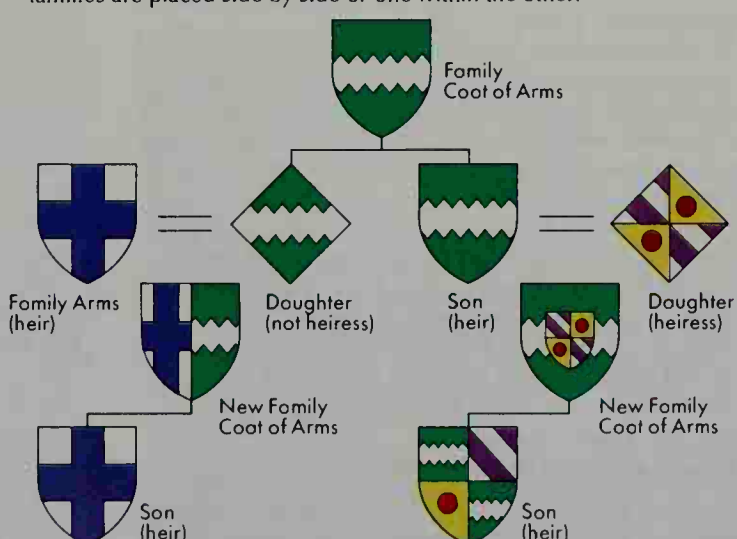


Kinds of charges

A charge is a symbol of an object or figure that appears on a shield. Animals are among the most popular charges.

Patterns of family relationships

Two or more arms were sometimes combined on one shield in order to show family relationships. The earliest methods of *marshaling*, as this procedure is called, are shown below. The arms of two families are placed side by side or one within the other.



accessories to the shield. For example, there may be a helmet above the shield and, on top of that, a crest. A cape, known as a *mantling,* may be attached to the helmet or draped around the shield. Many coats of arms have an accessory called a *supporter* on each side of the shield. Most supporters are animals or human beings.

Most coats of arms include an object or figure called a *charge* on the shield. Animals and plants are the most common charges, but they may not look as they do in nature. For example, a lion may be shown *couped* (with the tips of its head or limbs cut off). Gods, people, monsters, and certain lifeless objects are also used as charges. The shield and all accessories stand on a base, known as the *compartment,* or above a motto, which is called the *device.*

A family's coat of arms may indicate the *cadency* (status) of individual members or of different branches of the family. Symbols called *marks of cadency* designate these family relationships. For example, each son in a family uses a different, personal symbol to show his order of birth. Whitney Smith

See also **Cartouche; Chevron; Herald.**

Additional resources

Neubecker, Ottfried. *Heraldry.* 1976. Reprint. DIANE, 1999.
Woodcock, Thomas, and Robinson, J. M. *The Oxford Guide to Heraldry.* 1988. Reprint. Oxford, 1990.

Herb, *urb* or *hurb,* is a low-growing plant that has a fleshy or juicy stem when it is young. The stems of some herbs develop hard, woody tissue when they grow old. Most herbs are perennials. The tops of the plants die each growing season, but the roots remain alive and produce new plants year after year. Some herbs are annuals. They live for only one growing season and must be raised from seed each year. The word *herb* comes from the Latin word *herba,* meaning *grass, green stalks,* or *blades.* Botanists use the word to mean any plant with soft, succulent tissues. But many people use the word to mean only herbs with some economic value.

Some herbs are used in cooking to flavor foods. Others give scents to perfumes. Still others are used for medicines. Some herbs, such as balm and sage, are valued for their leaves. Saffron is picked for its buds and flowers. Fennel seeds are valuable in relishes and seasoning. Vanilla fruit pods yield vanilla flavoring. Ginseng is valued for its aromatic roots.

People often grow herbs in their gardens. Many kinds of herbs can also be raised indoors. The plants grow well with little care. Gardeners plant herbs in good soil that has been well cultivated. They choose a sunny spot that is easily accessible. When the herbs begin to grow, the gardener keeps the soil loose and free from weeds. The leaves, stems, or seeds of herbs can be used fresh, or they can be dried for later use. Dried herbs can be pounded to a fine powder, placed in airtight containers, and then stored. See Gardening (Food gardens).

Although herbs have little food value, they make food tasty and more flavorful. Cooking with herbs has become a culinary art, and it adds great variety to any menu. Richard C. Keating

Related articles in *World Book* include:

Balm	Boneset	Caraway	Cineraria	Fennel
Basil	Calendula	Catnip	Coriander	Figwort family
Bitters	Calla	Celandine	Elecampane	Geranium
Ginseng	Mint	Rosemary	Tarragon	
Horehound	Parsley	Saffron	Telegraph plant	
Horseradish	Pennyroyal	Sage	Thyme	
Lavender	Peppermint	Spearmint	Valerian	
Licorice	Portulaca	Spikenard	Vanilla	
Marjoram	Psyllium	Sweet cicely		
	Rape	Tansy		

Herbal medicine refers to plants or plant ingredients that are used to maintain or improve health. The plants and the plant products are called herbs, herbal remedies, herbal medicinals, medicinal herbs, medicinal plants, and phytomedicinals. The most popular herbal medicines include echinacea, thought to relieve cold symptoms; ginkgo and ginseng, sold to improve memory and alertness; and St.-John's-wort, which may relieve mild depression. Some herbs used to flavor food in cooking may have medical uses. For example, garlic may reduce the risk of heart disease.

Hundreds of herbal medicines are sold in a variety of settings. They are sold as *bulk* plants (loose or unpackaged), parts of those plants, and as powders, capsules, tablets, liquids, and *extracts.* Herbs are also found in combination products with other, nonherbal, ingredients. Bulk plants are used to prepare the other dosage forms. Extracts contain a stronger solution of some of the ingredients. The liquid extracts and pill forms are the most popular.

Many people view herbal medicines as milder or safer than other drugs, but some plants contain chemicals that are powerful drugs. In fact, about one-fourth of all prescription medicines come from plants.

The United States Food and Drug Administration (FDA) classifies herbal medicines as separate from nonprescription and prescription medicines. An herbal remedy is considered a *dietary supplement,* a product taken in addition to a normal balanced diet that is not a food or drug. Dietary supplements do not have to meet FDA rules for safety, effectiveness, and quality.

Scientists continue to research the safety and effectiveness of herbs. Even though herbal medicines are natural, they may cause side effects. Because herbal medicines react differently in different people, it is important to consult a doctor or pharmacist when taking them. The strength of the active ingredients in an herbal remedy may vary depending on how the plant is grown, harvested, stored, and prepared. An allergy, an impurity in the product, an interaction with other drugs, a misidentification of the plant, or the wrong dose all can cause unwanted effects. While the benefit of some herbal medicines may outweigh any risks, for some people the risk may be too high or unknown. Scientists are investigating the active substances, best doses, effects of other medicines or food, and the right ingredients of herbal medicines. Joseph I. Boullata

See also **Alternative medicine; Dietary supplement; Plant** (Medicines).

Herbarium, *hur BAIR ee uhm,* is an organized collection of dried plants. Herbariums serve an important function in the study of plants. They offer an easy way to examine many kinds of plants or many examples of one particular kind. Herbariums provide a valuable, permanent record of plant life.

Most specimens in a herbarium are glued to sheets of stiff paper. Some specimens, such as mosses, lichens,

and fungi, are placed in folded paper packets. Each specimen is labeled with its name, the place and date of collection, the name of the collector, and other information. A good specimen shows all parts of the plant, such as the root, leaf, flower, and fruit. If protected from pests and moisture, specimens will last for hundreds of years.

The most valuable specimens in a herbarium are those from which the first descriptions of their kind were made. This is because the most common use of a herbarium is for naming unidentified plant specimens. By making comparisons with original specimens, botanists determine the best name to use for an unidentified specimen. Herbarium collections are also used in studies of plants of a particular kind or of a particular area. A good herbarium has many specimens of each kind of plant from the area in which it is located.

The oldest herbarium in the United States is in the Academy of Natural Sciences of Philadelphia. This herbarium was founded in 1812. The largest herbarium in the United States, and the third largest in the world, is the National Herbarium in Washington, D.C. It has more than 5 million specimens. Only the herbarium of the Royal Botanic Gardens in Kew, England, and the herbarium of the Komarov Botanic Institute in St. Petersburg, Russia, are larger. David H. Wagner

Herbart, *HEHR bahrt,* **Johann Friedrich,** *YOH hahn FREE drihkh* (1776-1841), was a German philosopher and educator who greatly influenced educational theory of the late 1800's. He believed that education is closely related to *ethics* (the study of standards of right and wrong) and to psychology. Ethics provides the overall goal of education—to build strong moral character. Psychology furnishes the means of achieving this goal.

Herbart stressed the importance of developing and maintaining students' interest in learning. He called for four steps in teaching. First, the teacher presents information to students. Second, the instructor helps students analyze the new material and compare or contrast it with ideas they have already learned. Third, the teacher and the class use the new information to develop a general rule or principle. Fourth, the teacher helps students apply the new information in other situations or use the rule to solve other problems. Many educators in Europe and North America adopted Herbart's four steps, which his followers later expanded into five.

Herbart was born in Oldenburg, in what is now northern Germany. He studied philosophy at the University of Jena. In 1797, Herbart went to Switzerland. There he met the Swiss educator Johann H. Pestalozzi, who inspired many of his theories. Herbart taught education and philosophy at the University of Göttingen from 1802 to 1809 and at the University of Königsberg from 1809 to 1833. He then returned to Göttingen, where he taught until his death. Douglas Sloan

Herbert, Frank (1920-1986), was an American author of science fiction. He was best known for his *Dune* series of novels, which reflect his interests in ecology and politics. The series consists of *Dune* (1965), *Dune Messiah* (1969), *Children of Dune* (1976), *God Emperor of Dune* (1981), *Heretics of Dune* (1984), and *Chapterhouse: Dune* (1985). These works tell about life on a harsh desert planet called Arrakis, also known as Dune. The *Dune* novels, like Herbert's other works, have complex plots and strong philosophical and psychological themes. Herbert told in great detail the history and background of events in his stories.

Herbert's first novel, *The Dragon in the Sea* (1956), later titled *Under Pressure,* takes place in the 2000's and describes a four-man submarine crew on a mission to steal precious oil from enemy territory. *Destination: Void* (1966) was followed by two related novels coauthored with Bill Ransom, *The Jesus Incident* (1979) and *The Lazarus Effect* (1983). His other novels include *The Heaven Makers* (1968), *Hellstrom's Hive* (1973), and *The White Plague* (1982).

Frank Patrick Herbert was born in Tacoma, Washington. In addition to writing novels, he worked for many years as a newspaper reporter and editor. Neil Barron

Herbert, George (1593-1633), was a leading English poet of the 1600's. His major volume of poems, *The Temple* (1633), was published shortly after his death and achieved wide popularity and influence. In this collection of 164 short lyric poems, Herbert artfully and lovingly described what he called "the many spiritual conflicts that have passed betwixt God and my soul."

Herbert wrote mainly on religious subjects. In the poem "Jordan (II)," he declared, "There is in [God's] love a sweetness ready penn'd" that the poet needs only to "copy out." Herbert used great metrical variety, employing more than 140 different stanza patterns. He used intimate, sometimes homely imagery to express himself in poetry of great depth and emotional precision. Herbert's poems include "The Altar," "The Collar," "The Pulley," and three separate poems called "Love." In addition, he wrote the well-known Anglican hymn "Let All the World In Every Corner Sing."

Herbert was born into a noble Welsh family. He served in Parliament in 1624 and 1625. In 1626, he was ordained a deacon in the Church of England. He then worked his way through the spiritual conflicts described in *The Temple* and became rector at Bemerton, near Salisbury, in 1630. That same year, he was ordained to the priesthood. Gary A. Stringer

See also Metaphysical poets.

Herbert, Victor (1859-1924), an American composer and conductor, is often called "the prince of operetta." One of his most famous operettas, *Babes in Toyland* (1903), was based on Mother Goose and fairyland characters. "March of the Toys" and "Toyland" are well-loved numbers in this operetta. He also wrote *Mlle. Modiste* (1905), which includes the popular song "Kiss Me Again." *Naughty Marietta* (1910), one of the most tuneful of his operettas, includes such songs as "Ah! Sweet Mystery of Life," "I'm Falling in Love with Someone," "Italian Street Song," and "'Neath the Southern Moon."

Herbert was born in Dublin, Ireland. He studied the cello in Germany, and played in leading European orchestras. In 1886, he settled in New York City, where he played cello in the Metropolitan Opera Company Orchestra. In 1893, Herbert followed Patrick S. Gilmore as bandmaster of the Twenty-second Regiment Band. He wrote *Prince Ananias,* his first operetta to be staged, in 1894. It was not a great success, but *The Wizard of the Nile,* a year later, proved popular.

Herbert was appointed conductor of the Pittsburgh Symphony Orchestra in 1898, but resigned in 1904 to devote his time to composition. He was the first American composer to write an original score for a movie. His

other works include the operettas *The Fortune Teller* (1898), with the song "Gypsy Love Song"; *The Red Mill* (1906); *Sweethearts* (1913); *Princess Pat* (1915); *Eileen* (1917), with the song "Thine Alone"; and *The Dream Girl* (1924). He composed two grand operas, *Natoma* (1911) and *Madeleine* (1914). Gerald Bordman

Herbicide, *HUR buh syd,* is a chemical compound used to control or destroy unwanted plants. Herbicides are sometimes called *weedkillers.* Farmers and ranchers use herbicides to control weeds growing among crops. People also use herbicides to eliminate weeds from lawns, parks, industrial sites, and other areas.

There are two types of herbicides, *selective* and *nonselective.* Most herbicides are selective—that is, they kill weeds but do not harm crops. Nonselective herbicides destroy all plants. Nonselective herbicides called *soil sterilants* are used along driveways, railroads, and other places where people do not want plants to grow.

Herbicides have been used since the early 1850's, when salt was spread to control unwanted plants. Salt, copper sulfate, and other early herbicides were nonselective. Selective herbicides came into use in 1944 with the development of *2,4-D.* This herbicide is still used to kill such broadleaf weeds as cocklebur and pigweed.

How herbicides work. Herbicides are manufactured in the form of tiny particles or a liquid. They are sprayed on growing weeds or on the soil. Many herbicides control weeds by preventing weed seeds from sprouting. These herbicides are mixed into the soil before or at the time that crops are planted, or applied to the soil surface before crops and weeds start to grow. Some herbicides kill plants by hindering photosynthesis, the process by which plants convert carbon dioxide and water into food. Others, called *growth regulator herbicides,* cause plants to die prematurely by altering their growth patterns. Most growth regulator herbicides are applied after the crop or weed appears above the soil surface.

Hazards of herbicides. In the United States, the Environmental Protection Agency (EPA) regulates the use of herbicides and registers their safe uses. The EPA has approved more than 180 herbicides. Most of them do not endanger human beings, animals, or the environment if used as directed by the manufacturer. However, some herbicides are poisonous and must be used with extreme care. All herbicides should be stored where children and animals cannot get to them.

In the 1960's and 1970's, a mixture of the herbicides 2,4-D and 2,4,5-T was widely used to *defoliate* (cause leaves to fall off) trees and brush. During the Vietnam War, this mixture became known by the military code name *Agent Orange.* United States forces sprayed it on the trees of jungles in South Vietnam to expose enemy snipers. During the early 1970's, researchers found that Agent Orange and all other 2,4,5-T products contained a highly poisonous substance called *dioxin.* Dioxin contamination was a possible health hazard to people and animals. In 1984, the Environmental Protection Agency banned all use of 2,4,5-T. Harold D. Coble

See also Agent Orange; Dioxin; Pest control.

Herbivore, *HUR buh vawr,* is any animal that eats chiefly plants. Herbivores are also called *herbivorous animals.* Animals that primarily eat the flesh of other animals are called *carnivores.* Those that eat both animals and plants are called *omnivores.*

There are many kinds of herbivores. Some, such as cattle, deer, and horses, eat grasses. Others, including many birds, eat seeds. Earthworms are among the herbivores that eat dead plant material. James L. Patton

See also Carnivore; Mammal (illustration: The teeth of mammals).

Herblock. See Block, Herbert Lawrence.

Hercegovina. See Bosnia-Herzegovina.

Herculaneum, *HUR kyuh LAY nee uhm,* was an ancient Roman city in Italy. Like Pompeii and Stabiae, it was buried when Mount Vesuvius erupted in A.D. 79. But the mud and lava that buried Herculaneum also preserved it as a record of life in ancient times. Fifteen hundred years later, archaeologists dug through the hardened layers of mud and lava and found priceless manuscripts, works of art, and tools of daily life.

Herculaneum was a small, pleasant city with a good harbor. It stood at the foot of Mount Vesuvius, 6 miles (10 kilometers) from Naples. The city had strong fortifications and was the home of many artistic treasures. Herculaneum was badly shaken by an earthquake in A.D. 63, but the damage was repaired.

Sixteen years after the earthquake came the volcanic eruption that buried Herculaneum, Pompeii, and Stabiae, killing thousands of people. Pompeii and Stabiae were covered by ashes and lava. They were not as well preserved as Herculaneum, which was buried under a flow of lava and mud that was 100 feet (30 meters) deep in some places.

A village later grew up near the site of Herculaneum. In the early 1700's, a farmer sank a shaft for a well, and found marble statues far below the surface. Soon afterward, someone sank another shaft, and discovered a theater. The government of Naples took up the task of excavation in 1738. The deposits were much deeper at Herculaneum than at Pompeii, so digging was more difficult. Excavation was stopped in the 1800's but resumed in 1926 by the Italian government.

The site is honeycombed by tunnels that robbers dug. It is believed thieves have carried off many priceless works of art. But the excavators found wonderful marble and bronze statues, paintings, and papyrus rolls. Most of these works are housed at the National Archaeological Museum in Naples. Mary Francis Gyles

See also Pompeii; Vesuvius.

Hercules, *HUR kyuh leez,* was one of the greatest heroes of Greek mythology. The Greeks called him *Heracles,* but he is usually known as *Hercules,* the name used by the Romans.

Early life. Hercules was born in Thebes. He was the son of the princess Alcmene, a mortal, and Zeus, the king of the gods. Hera, the wife of Zeus, was jealous of Alcmene and hated Hercules. She persecuted Hercules throughout his life. When Hercules was an infant, Hera sent two serpents to kill him. However, Hercules strangled the snakes. As a young man, Hercules had a vision. In it, he was offered a choice of a life of ease, pleasure, and vice, or one of hardship, danger, glory, and virtue. He chose the more difficult—but virtuous—life.

The twelve labors. Hera caused Hercules to have a fit of madness, during which he killed his wife, Megara, and their children. The oracle at Delphi told Hercules that he had to serve King Eurystheus of Tiryns for 12 years to purify himself of the murders.

Eurystheus commanded Hercules to perform 12 labors, which are described, with many variations, by a number of ancient authors. This section deals with the most generally accepted versions of the labors.

The first six labors took place near Thebes. First, Hercules killed the fierce lion of Nemea, whose skin he then wore as a trophy. Next, with the help of his nephew Iolaus, Hercules slew the deadly Hydra of Lerna. This serpent had several heads that grew back as soon as they were cut off. Hercules cut off the heads, and Iolaus sealed each neck with fire to prevent them from growing back. The hydra also had one head that was immortal, which Hercules buried under a rock. He then used the hydra's blood to poison his arrows.

For the third and fourth labors, Hercules captured the huge boar of Erymanthus and the golden-horned Arcadian stag. For his fifth labor, he drove a flock of ferocious birds away from the woods near Lake Stymphalus. These birds had arrowlike feathers that they shot at people. Next, Hercules cleaned the stables of King Augeas by making two rivers flow through them.

The second six labors took Hercules increasingly far from his home. For the seventh labor, he traveled to Crete to capture the bull of King Minos. For the eighth, Hercules brought the horses of King Diomedes of Thrace to Eurystheus. These horses ate human beings, but Hercules tamed them by feeding them Diomedes. For the ninth labor, Hercules obtained the *girdle* (belt) of Hippolyta, the queen of the Amazons, by defeating her in battle (see **Amazons**).

To perform the 10th and 11th labors, Hercules journeyed to the western edge of the ancient world. First, he captured the cattle of the fearful monster Geryon. Then he stole the Golden Apples of the Hesperides from the Tree of Life (see **Hesperides**). For his 12th labor, Hercules descended into the world of the dead, captured the three-headed watchdog Cerberus, and brought him back to the upper world (see **Cerberus**). The last three labors represented the conquest of death, and Hercules achieved immortality by carrying them out.

Other adventures of Hercules included accompanying the Argonauts on part of their voyage in search of the Golden Fleece. He also restored Alcestis, the wife of King Admetus, to life by outwrestling Death. Hercules released Prometheus from the punishment to which Zeus had condemned him. Also, Hercules overcame the giant Antaeus, whose strength was renewed by contact with his mother, Earth, by holding him off the ground until he weakened. See **Argonauts; Prometheus.**

The death of Hercules. Some time after completing the 12 labors, Hercules married the princess Deianira. The centaur Nessus tried to rape Deianira, and Hercules shot him with a poisoned arrow. The dying centaur told Deianira to smear some of his blood on Hercules's robe if she ever needed to win back his love. After Hercules fell in love with another princess, Iole, Deianira followed Nessus's advice. But the centaur's blood had been poisoned by Hercules's arrow. When Hercules put on the robe, it burned him so terribly he pleaded to be placed on a funeral pyre. His body was consumed by flames, and he was taken to Mount Olympus, home of the gods. There, he became a god. Nancy Felson

See also **Atlas** (god); **Cornucopia; Hebe; Renaissance** (picture: Mythological subjects).

Hercules is a constellation of the Northern Hemisphere between Corona Borealis and Lyra. It is best seen high overhead in summer. The red star marking the head of Hercules lies toward the south. It is actually a pair of stars (see **Binary star**). The red star is a giant, hundreds of times larger than the sun. In the northwest side of Hercules, a cluster numbering more than 100,000 stars appears. It is so far away that its light requires more than 30,000 years to reach the earth. Even under good conditions, the cluster is barely visible to the naked eye. In 1934, a star in Hercules exploded, throwing huge masses of gas and dust into space. As a result, the star suddenly became much brighter. Such an explosion is called a *nova*. The star has since faded to its normal brightness. Sumner Starrfield

Hercules beetle is the name of several large, strong beetles that live in North America. Male Hercules beetles have long horns that project from the head and front upper part of the body. The horns are curved to meet each other and look like pincers. Males of one species found in the West Indies grow 5 to 6 inches (13 to 15 centimeters) long. The horns may make up more than half of the beetle's length. The *eastern Hercules beetle* is found from New Jersey to Pennsylvania and west to Indiana, Oklahoma, and Texas. It is greenish with dark spots. The *southwestern Hercules beetle* is darker in color and has longer horns. It lives in the southwestern part of the United States. David J. Shetlar

Scientific classification. Hercules beetles are in the scarab family, Scarabaeidae. The scientific name for the eastern Hercules beetle is *Dynastes tityus*. The southwestern Hercules beetle is *D. granti*.

See also **Beetle** (picture).

Herder, Johann Gottfried von (1744-1803), was one of the most original and versatile German writers, critics, and philosophers of the 1700's. His new ideas in art, poetry, language, and history had a lasting influence on German intellectual history.

Herder became the philosophical leader of the *Sturm und Drang* (Storm and Stress) movement of the 1770's, inspiring Johann Wolfgang von Goethe and other writers. Herder tried to free German literature from imitating French neoclassicism. He argued that the works of William Shakespeare and folk poetry were closer to German taste. Herder's interpretations of Shakespeare and his collection of popular songs and ballads, *Folk Songs* (1778-1779), later published as *Voices of Nations in Songs* (1807), influenced German romantic writers. His *Ideas on the Philosophy of the History of Mankind* (1784-1791) added to our understanding of civilization. He explained cultural history as an evolution of nature rather than an expression of the rational free will of humans.

Herder was born in Mohrungen, East Prussia. From 1762 to 1764, he studied theology at the University of Königsburg. Herder served from 1764 to 1769 as a successful teacher and preacher in Riga, Latvia. He then traveled through Europe. He met Goethe in Strasbourg, and they became friends. In 1771, Herder became court preacher at Bückeburg. Through Goethe's influence, Herder was appointed general superintendent of churches and schools at Weimar in 1776, and he settled there permanently. Klaus L. Berghahn

See **German literature** (The Storm and Stress movement); **Goethe, Johann Wolfgang von** (Early years).

Norvia Behling

Brian Parker, Tom Stack & Assoc.

Heredity affects all living things. Heredity explains why human mothers always have human children and cats always have kittens, *left.* The process of heredity also occurs among all plants and even among one-celled organisms, such as a paramecium, *right.*

Heredity

Heredity is the passing on of biological characteristics from one generation to the next. The process of heredity occurs among all living things—animals, plants, and even such microscopic organisms as bacteria. Heredity explains why a human mother always has a human baby and why a mother dog has puppies—not kittens. It is also the reason offspring look like their parents.

Through heredity, living things inherit characteristics, often called *traits,* from their parents. You resemble your parents because you inherited your hair color, nose shape, and other traits from them. All organisms consist of cells. Tiny biochemical structures inside each cell called *genes* carry traits from one generation to the next. Genes are made of a chemical called *DNA (deoxyribonucleic acid).* They are strung together to form long chains of DNA in structures known as *chromosomes.*

Genes are like blueprints for building a house, except that they carry the plans for building cells, tissues, organs, and bodies. They have the instructions for making the thousands of chemical building blocks in the body. These building blocks are called *proteins.* Some proteins are responsible for the size, shape, and structure of the parts making up your body. Other proteins, known as *enzymes,* make possible the thousands of chemical reactions that occur constantly in your body and in all other living things. The process by which the cell makes a protein according to the instructions carried by a gene is known as *gene expression.*

Genes have powerful effects, but they do not control all of life. Most characteristics result from a combination of heredity and environment. For example, you may have inherited a talent for playing the piano. But you will not be able to play unless you take lessons and practice. The talent is hereditary. The lessons and practice are environmental.

The basic laws of heredity were formulated during the mid-1800's by an Austrian botanist and monk named Gregor Mendel. Mendel based his laws on his studies of the inheritance patterns of garden peas. Although Mendel published the results of his experiments in 1866, his work went unnoticed until 1900.

Mendel's experiments laid the foundation for the scientific study of heredity, called *genetics.* Through the years, *geneticists*—that is, people who study heredity—have learned much about why human beings and other living things look and behave the way they do. These scientists have also begun to uncover the causes of hereditary diseases and to develop ways to treat them. Today, genetics has several specialized branches.

The contributors of this article are Robert F. Weaver, Professor of Biochemistry at the University of Kansas, and Philip W. Hedrick, Professor of Zoology at the University of Arizona. They are coauthors of Basic Genetics *and* Genetics.

Molecular genetics, for example, involves the study of the chemical nature and activities of genes. For more information on the various branches of genetics, see Genetics.

Chromosomes and genes

The structure of chromosomes and genes. In human beings and most other organisms, chromosomes are found in the part of a cell known as the *nucleus.* Chromosomes are tiny threadlike structures made largely of DNA and proteins. Chromosomes generally occur in pairs. The two chromosomes in a pair resemble each other in size and shape. They also contain similar hereditary information.

Each species of animal and plant has a characteristic number of chromosomes in its *body cells.* Body cells, often called *somatic cells,* are the cells that make up such body parts as muscles and bones. Body cells differ from *sex cells.* In male animals, the sex cells are sperm; in plants, pollen. In female animals and plants, the sex cells are eggs. Human beings typically have 46 chromosomes, arranged in 23 pairs, in their body cells. Dogs have 78 (39 pairs), and corn has 20 (10 pairs). The fruit fly *Drosophila melanogaster,* which is widely used in genetic research, has only 8 chromosomes (4 pairs).

Genes are the basic units of heredity. Each gene consists of a section of an extremely long DNA molecule found in a chromosome.

Every species of plant and animal has a certain number of genes on its chromosomes. For example, scientists estimate that human beings have 30,000 to 40,000 different genes. Roundworms may have about 18,000 different genes, and fruit flies may have about 13,000. A set of all the genes a species has on its chromosomes is called its *genome.*

Sex cells and reproduction. There are two general types of reproduction, *asexual* and *sexual.* Asexual reproduction involves only one parent. The offspring have chromosomes identical to those of the parent. When a worm called a planarian reproduces asexually, for example, its body divides into two sections. One has the head, and the other has the tail. Each section grows the parts that are missing and becomes a new individual that is genetically identical to its parent.

Sexual reproduction generally involves two parents, each of which contributes half the chromosomes to the offspring. Sexual reproduction starts with the production of specialized sex cells that are called *gametes.* Gametes—that is, sperm, pollen grains, and eggs—are produced in a process of cell division called *meiosis.* Meiosis results in the sex cells' having half the number of chromosomes found in the body cells. In human beings, therefore, meiosis produces sperm and egg cells that have 23 chromosomes each. In dogs, the number of chromosomes in each sex cell is 39.

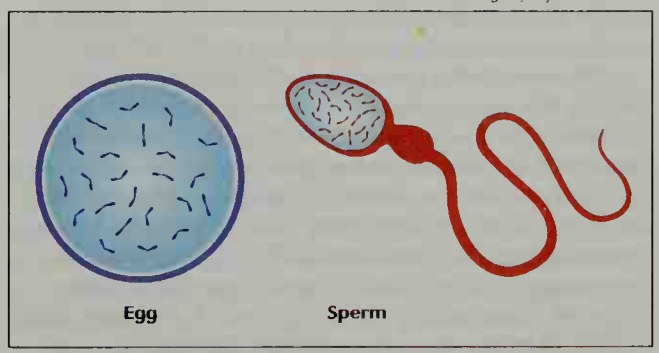
The uniting of an egg cell and a sperm cell, called *fertilization,* restores the full number of chromosomes. In human beings, the resulting cell, known as a *fertilized egg,* has 46 chromosomes, 23 pairs. One chromosome of each pair comes from the mother's egg, and the other from the father's sperm. After the egg has been fertilized, it begins to divide and produce exact copies of itself by a type of cell division called *mitosis.* Each of the new cells, known as *daughter cells,* has the same num-

Heredity terms

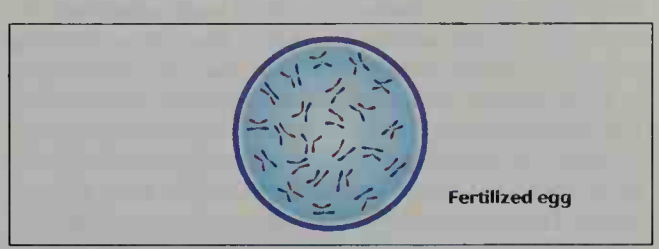
Alleles are different forms of the same gene.
Chromosomes are tiny threadlike structures inside each cell. Chromosomes carry the genes.
DNA stands for *deoxyribonucleic acid.* It is the substance within the chromosomes that carries the hereditary instructions for producing proteins and RNA's.
Gene expression is the process by which a cell makes a protein or RNA according to the instructions carried by a gene.
Genes are tiny biochemical structures inside each cell that determine particular hereditary traits, such as eye color and blood type. Each gene is a segment of DNA that carries instructions for producing the chainlike molecules that make up proteins.
Genetic variation refers to the differences in inherited traits that exist among the members of a species.
Genetics is the scientific study of heredity.
Genome is a set of all the genes a species has on its chromosomes. The human genome consists of 30,000 to 40,000 genes.
Genotype is the underlying genetic makeup of a trait or the overall genetic makeup of an individual.
Mutation is a change in a gene. It may produce a new trait that can be inherited.
Phenotype is the observable appearance of a trait or the overall appearance of an individual.
Protein is a chemical building block in the body. Proteins exist in every cell.
RNA stands for *ribonucleic acid.* Similar to DNA, it plays a key role in the production of proteins.
Trait is a characteristic, such as hair color.

How chromosomes are inherited

WORLD BOOK diagrams by Mark Swindle



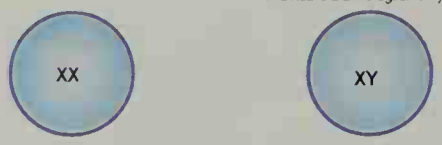
The sex cells—that is, eggs in females and sperm in males—are produced in a process called *meiosis.* As a result of this process, mature sex cells, such as those shown above, have half the number of chromosomes found in other cells in the body. Each human egg and sperm cell thus has 23 chromosomes.



When a sperm unites with an egg, the resulting *fertilized egg* has the 46 chromosomes of a normal body cell. The chromosomes are arranged in 23 pairs. One chromosome in each pair comes from the mother, and the other comes from the father.

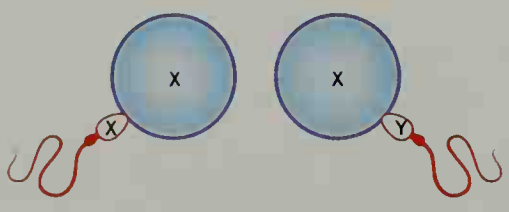
How a person's sex is determined

WORLD BOOK diagrams by Mark Swindle



Chromosomes known as X and Y chromosomes determine whether a fertilized egg will become a girl or a boy. An immature female sex cell has matching X chromosomes. An immature male sex cell has an X chromosome and a Y chromosome.

When an immature female sex cell divides, each resulting mature egg cell receives a single X chromosome. When an immature male sex cell divides, half the resulting mature sperm cells receive an X chromosome, and half receive a Y chromosome.



An egg fertilized by a sperm cell containing an X chromosome has two X chromosomes, *left.* It will develop into a girl. An egg fertilized by a sperm with a Y chromosome has one X and one Y chromosome, *right.* Such an egg will develop into a boy.

ber of chromosomes as the original cell. For more information on meiosis and mitosis, see **Cell** (Cell division).

Chromosomes and sexual determination. In human beings, chromosomes known as X and Y chromosomes determine an individual's sex. Eggs always have an X chromosome, but sperm may have either an X or a Y chromosome. When a Y-carrying sperm fertilizes an egg, the baby will be a boy (XY). If the sperm has an X chromosome, then the baby will be a girl (XX). Males produce sperm with an X chromosome in numbers equal to sperm with a Y chromosome. As a result, about half of all babies are boys, and half are girls.

Patterns of heredity

Dominant and recessive genes. Most genes occur in pairs. Each pair of genes is contained in a pair of matching chromosomes, with one copy of a gene in each chromosome. Some hereditary traits are determined by a single pair of genes. For example, a chemical called *phenylthiocarbamide* (PTC) tastes extremely bitter to some people. Other people cannot taste PTC at all. The difference between tasters and nontasters is due to a single pair of genes. But many other traits, called *polygenic traits,* are influenced by a number of pairs of genes. Tens or hundreds of pairs of genes are involved in the inheritance of such traits as height, weight, and intelligence.

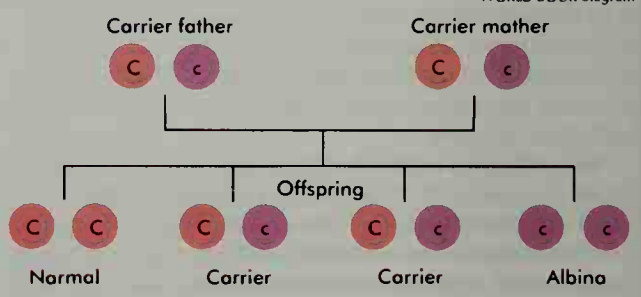
The two genes in a pair may differ in the effects they produce. Different forms of the same gene are called *alleles.* Some alleles are *dominant,* and others are *recessive.* A dominant allele masks the effects of its recessive partner. In other words, the dominant allele is expressed, and the recessive allele is not. A trait that results from a recessive allele is evident only in an individual that has two recessive alleles for that trait. For example, Mendel showed that in pea plants the allele that produces violet flowers (symbolized by *V*) is dominant over the one that causes white flowers *(v).* Pea plants that have two dominant alleles for violet flowers *(VV)* or one allele for violet flowers and one for white flowers *(Vv)* will have violet flowers. Only those with two recessive alleles *(vv)* will have white flowers.

Sex-linked genes. Genes that lie near each other on the same chromosome are called *linked genes* because they tend to be inherited together. Genes on the sex chromosomes are called *sex-linked genes.* Human beings have more than 250 genes on the X chromosome—called *X-linked* genes—that can cause hereditary disorders. These disorders include hemophilia and a type of muscular dystrophy. Most of these disorders are recessive. They typically occur only in males because males have only one X chromosome. Females have two X chromosomes. Generally, at least one of the two X chromosomes has the dominant normal allele. This allele deter-

The transmission of albinism

Albinism is a hereditary condition in which an organism cannot produce pigment. Albinism occurs in human beings and in many species of plants and animals.

WORLD BOOK diagram



Different forms of the same gene are called *alleles.* The allele that produces pigment is *dominant* and masks the effects of the albinism allele, which is *recessive.* As a result, albinism occurs only in individuals who have two alleles for that trait. In the chart above, each parent carries one normal allele (C) and one albinism allele (c). Individuals who inherit the albinism allele from only one parent are not albinos. But they may transmit the allele to their young, as shown in the photograph below of a multicolored mother rabbit and her albino offspring.

Norvia Behling

mines the trait, and the harmful gene on the other X chromosome does not.

Sources of genetic variation

Individual members of a species differ widely from one another in their genetic makeup and therefore in their traits. You may look like your parents, but you are not an exact duplicate of either of them. You inherited half your genes from your father and half from your mother. Nor do you look exactly like your classmates, even though you and your classmates are all human beings. Scientists refer to the differences among members of a species as *genetic variation.* This section discusses the main sources of diversity among individual members of a species—mutation and genetic recombination. The next section, *Heredity and natural selection,* describes how entire species and certain groups within species change over time.

Mutation is a permanent change in the amount or the structure of the DNA in an organism's cells. It can result in alterations in gene expression and therefore in traits.

Kinds of mutations. Mutations can occur in sex cells or in body cells. A *germinal mutation* affects the DNA in the gametes and is therefore passed on from an organism to its offspring. A *somatic mutation* occurs in body cells. In human beings and other animals, somatic mutations do not affect the gametes. Consequently, the changes are not inherited by succeeding generations. However, the changes are passed along to the daughter cells of the original mutant cell.

Many mutations affect entire chromosomes. In some cases, an organism has too many or too few chromosomes. For example, people with a condition called *Down syndrome* have an extra copy of chromosome 21, one of the 23 pairs of chromosomes. Sometimes the structure of a chromosome is abnormal. For example, a mutation called *translocation* occurs when a piece of one chromosome breaks off and attaches to another.

Some mutations affect only one or a few of the chemical units making up the DNA molecule. There are several kinds of these *point mutations* or *gene mutations.* For example, a *missense mutation* changes a single pair of chemical units, thereby altering the instructions carried by that segment of DNA.

Causes of mutations. Some mutations result from mistakes that occur when copies of DNA are made during cell division. Others are caused by agents called *mutagens.* Mutagens include certain chemicals and various forms of radiation.

Genetic recombination. When organisms mate, new combinations of traits appear in their young. These combinations occur by (1) independent assortment of the genes on different chromosomes, and (2) crossing over.

Independent assortment refers to the way in which chromosomes and their genes are distributed when a sex cell divides to form eggs or sperm. An immature sex cell contains two of each chromosome—one from the individual's father and one from the mother. During meiosis, each pair of chromosomes separates, and each egg or sperm receives one chromosome from each pair. Because the chromosomes separate in a random manner, each egg or sperm receives some chromosomes from the individual's mother and some from the father. This reshuffling of chromosomes and genes can result in new combinations of traits in offspring.

Crossing over is the exchange of genes between two partner chromosomes. Genes on separate chromosomes are inherited in a random and independent manner. But genes located close to each other on the same chromosome are generally inherited together. In other words, genes that are closely linked on a parent's chromosome largely remain linked in offspring.

Sometimes, however, linked genes are not inherited together. This situation arises because of crossing over. Just before immature sex cells divide to form sperm or eggs, each chromosome of a pair lines up side by side with its partner chromosome. During a crossing-over event, groups of genes from one chromosome change places with groups of genes from its partner chromosome. As a result, different sperm or eggs may carry different combinations of linked genes.

Heredity and natural selection

Mutation is one of the chief sources of new genetic material for a species or a *population*—a group of individuals of the same species living in the same area. Genetic recombination provides new combinations of mutations. As these two sources of genetic variation work together with a process called *natural selection* over time, the genetic makeup of a species or population changes.

Natural selection. Many mutations that alter traits are harmful, but some mutations and combinations of mutations make certain individuals better able to survive, mate, and reproduce in a given environment. These individuals will likely have more offspring that survive than individuals without the particular genetic variation. The young of the better-suited parents inherit the genes for the favorable characteristics that enabled their parents to improve their chances of surviving, mating, and reproducing. They then pass the genes along to their own offspring. As this process is repeated through many generations, more and more members of the species or population come to have the favorable genes. In this way, the process of natural selection changes the genetic makeup and therefore the traits of organisms through time.

Generally, evolution by natural selection takes place slowly and is not noticeable in a human lifetime. However, a species may change quickly in response to a major alteration in the environment, such as pollution or the introduction of a pesticide.

An example of a rapid genetic change occurred in Britain during the 1800's with a species of moth called the peppered moth. Peppered moths rest on light-colored lichens that grow on tree trunks. During the early 1800's, nearly all peppered moths were light-colored, and only a few moths carried a mutation that made them black. In the mid-1800's, however, factories burned so much coal that soot settled over the countryside, killing the lichens and blackening the tree trunks. Light-colored moths on dark-colored trees were easily seen and eaten by birds. But the birds could not see the black moths well. As a result, more of the black moths survived and produced offspring. Within 50 years, most moths in heavily polluted areas were black. After air pol-

lution laws were passed in the mid-1900's, the tree trunks became lighter as lichens again grew on them, and the number of light-colored moths increased.

Gene pools and allele frequency. The genes of all the individuals of a population are called a *gene pool.* The degree to which a particular allele is present in a population is called the *allele frequency.* The level of diversity in a gene pool is important because genetic variation is necessary for a population to adapt to changes in the environment. For example, an insect population that has a genetic variant for resisting a new pesticide in its environment will be more likely to survive. There will be strong selection for that variant, and its frequency in the gene pool will increase. On the other hand, an insect population that does not have such a variant will die off.

Several factors besides natural selection may influence the frequency of particular alleles in a gene pool. These factors include *gene flow* and *genetic drift.*

Gene flow is the transfer of genes from one population to another. When separate populations come into contact and interbreed, new genes or combinations of genes are introduced into each group. Consequently, the gene pool of each group comes to include genes from pools of the other populations. In this manner, the allele frequencies of populations may change over time.

Genetic drift refers to chance increases or decreases in allele frequencies of a population from generation to generation. The genes of each generation represent only a sample of the previous generation's gene pool. As a result, the allele frequencies of each generation of individuals tend to vary randomly within the limitations of the preceding generation's gene pool. Such changes will probably have little effect on each generation in large populations. But they can lead to major genetic changes in small ones in a short period.

For a more detailed discussion of the factors involved in genetic variation among human populations, see **Races, Human** (How human populations develop and change).

Hereditary disorders

Many diseases and disorders are caused by such agents as viruses and bacteria. In other cases, however, the cause of the problem is hereditary—that is, the organism has inherited one or more abnormal genes from its parents. Because genes carry chemical instructions for the formation of proteins, defective genes can affect the production and function of proteins. For example, hemophiliacs are born with a defective gene, and thus they are unable to produce a protein crucial for blood clotting. As a result, they suffer prolonged bleeding when they are injured because their blood clots slowly.

Genes are arranged in an exact order along the length of the chromosomes. Researchers use a process known as *gene mapping* to locate and identify genes on a chromosome. This process has helped scientists determine which genes are responsible for some hereditary conditions. For example, Huntington's disease, a severe disorder of the nervous system, is caused by an abnormal gene on chromosome 4.

Many diseases, such as diabetes and rheumatoid arthritis, are common in certain families. These diseases are therefore believed to have a hereditary basis. People inherit a tendency to develop these conditions, but not the diseases themselves. Environmental factors may play a role in whether the conditions actually develop. For example, people with a genetic tendency toward diabetes may increase their chance of getting the disease by overeating and not getting enough exercise.

Scientists have developed methods of treating some hereditary disorders. For example, hemophilia can be treated by injections of the clotting factor that is missing from the blood of people who have the condition.

A technique known as *gene therapy* may offer a way

Inherited disorders

This table lists the symptoms and treatment of several hereditary disorders. As scientists learn more about genes, they are discovering that certain diseases have a genetic basis. For example, defective genes are responsible for some cases of breast cancer and of the brain disorder called Alzheimer's disease.

Name	Symptoms	Treatment
*Cystic fibrosis	Lung, pancreas, and liver damage due to abnormal mucus production	Drugs, physical therapy; experimental gene therapy; no cure
†Duchenne muscular dystrophy	Progressive weakening of the muscles	Drugs, physical therapy; no cure
*Hemophilia	Uncontrolled internal and external bleeding	Controlled by injections of missing blood-clotting factor
*Huntington's disease	Loss of muscle control and mental ability, usually in midlife	None
*Phenylketonuria	Mental retardation	Special diet to prevent onset of symptoms
*Retinoblastoma	Cancer of the eye in childhood	Radiation, drugs, surgery; usually curable if caught early
*Sickle cell anemia	Anemia, blood clots, damage to organs and nervous system	Drugs to ease symptoms; bone marrow transplant
*Tay-Sachs disease	Severe brain damage in infancy	No treatment or cure

*Has a separate article in *World Book.*
†See Muscular dystrophy.

of treating hereditary disorders and certain other diseases. Such therapy involves identifying the gene that causes a genetic disease and then supplying patients with a normal copy of that gene. The normal genes come from another individual or organism and are usually inserted into a patient's cells outside the body. The altered cells are then returned into the patient's body. See **Gene therapy.**

Couples who are planning to have children can be tested to see if they carry certain potentially harmful genes. These tests are usually done as part of a process called *genetic counseling.* This process enables couples to understand their chances of bearing children with hereditary disorders. It also helps them learn ways of dealing with their situation. See **Genetic counseling.**

Heredity and environment

A gene gives only the potential for the development of a trait. How this potential is achieved depends partly on the interaction of the gene with other genes. But it also depends partly on the environment. For example, a person may have a genetic tendency toward being overweight. But the person's actual weight will depend on such environmental factors as how much and what kinds of food the person eats.

The underlying genetic makeup of a trait is called the *genotype.* The actual appearance of the trait is known as the *phenotype.* Sometimes the word *phenotype* is used to refer to the overall appearance of an individual; *genotype,* to refer to the person's overall genetic makeup.

Scientists have long debated the relationship between heredity and environment in determining a person's physical appearance and behavior. This debate is often referred to as the question of *nature versus nurture*—that is, heredity versus environment.

To try to understand the influence of genetics and the environment on phenotype, researchers have often studied identical twins, who have the same genotype. Such studies have shown that identical twins raised apart and thus in different environments tend to vary more in their characteristics than identical twins raised together. As a result, scientists have concluded that both heredity and environment play important roles in what an individual's ultimate phenotype will be.

Intelligence and other mental traits also depend on heredity and environment. Every person is born with a certain mental capacity that influences how intelligent he or she will be as an adult. The development of this capacity is influenced by the person's environment. For example, severely undernourished infants may fail to develop their natural abilities.

The flow of genetic information

Genes and proteins. Genes carry the instructions for producing proteins. Proteins are large, complex molecules made up of smaller units called *amino acids.* Twenty kinds of amino acids are commonly found in proteins. Various combinations of these amino acids are linked to form long chains known as *polypeptides.* Polypeptide chains fold into complex three-dimensional shapes.

Proteins consist of one or more polypeptide chains. These chains vary greatly in length, from only a few amino acids to thousands. They also differ according to the order in which the amino acids occur. The length of the polypeptide chains and the arrangement of their amino acids determine the protein's shape and function. In most cases, one gene is responsible for making one polypeptide. The gene determines the order and number of amino acids in the polypeptide and thus the shape and function of the protein.

Grant Heilman

The effects of environment can be seen in these corn plants. All were grown from identical seeds and so have identical *genes* (units of heredity). However, the plants on the right grew in soil that lacked some nutrients needed for proper growth.

Proteins are found in every cell and are essential to plant and animal life. The proteins called *enzymes* speed up the chemical processes of life. Without enzymes, most of the reactions that occur in living things would happen too slowly to make life possible. These reactions include breaking down food during digestion and burning carbohydrates and fat for energy.

Many other proteins serve as building blocks for cells. Cells have different sizes and shapes—and different kinds, numbers, and arrangements of proteins—depending on where they are in an organism. Hair, nails, and part of the skin are made of a tough protein called *keratin.* The red color in blood comes from a red protein called *hemoglobin* that carries oxygen from the lungs to all parts of the body. Muscles consist largely of two proteins called *myosin* and *actin.*

The structure of DNA. The genes of all living things except some viruses are composed of DNA, which is often referred to as the *hereditary material.* DNA is a thin, chainlike molecule made up of smaller chemical units called *nucleotides.* A nucleotide in DNA is composed of a sugar known as *deoxyribose,* an oxygen-phosphorus chemical group called a *phosphate,* and a nitrogen-containing compound known as a *base.* The sugar and phosphate are the same in all DNA nucleo-

tides, but the bases vary. There are four DNA bases: adenine (A), guanine (G), thymine (T), and cytosine (C).

DNA consists of two chains that coil around each other in a shape called a *double helix*. The double helix resembles a twisted ladder. The sides of the ladder consist of the linked sugars and phosphates of the nucleotides. Each rung is made up of two paired bases.

Base pairs. The bases of a DNA molecule are paired in a specific way to form combinations known as *base pairs*. There are A-T and G-C base pairs. Wherever there is adenine in one strand, there is thymine in the opposite strand. Wherever there is guanine in one strand, there is cytosine in the other. Other combinations are extremely rare. Because of this specific pairing of the bases, scientists say the two DNA strands are *complementary*. The sequence of bases in one strand determines the sequence of bases in the other.

DNA molecules in human beings typically have more than 100 million base pairs and measure more than 1 inch (2.5 centimeters) long when uncoiled. However, DNA is so thin it can be seen only with the aid of special microscopes called *electron microscopes*. A typical DNA molecule has a thickness of only 20 *angstroms*. One angstrom equals 0.0000001 millimeter (0.0000000039 inch).

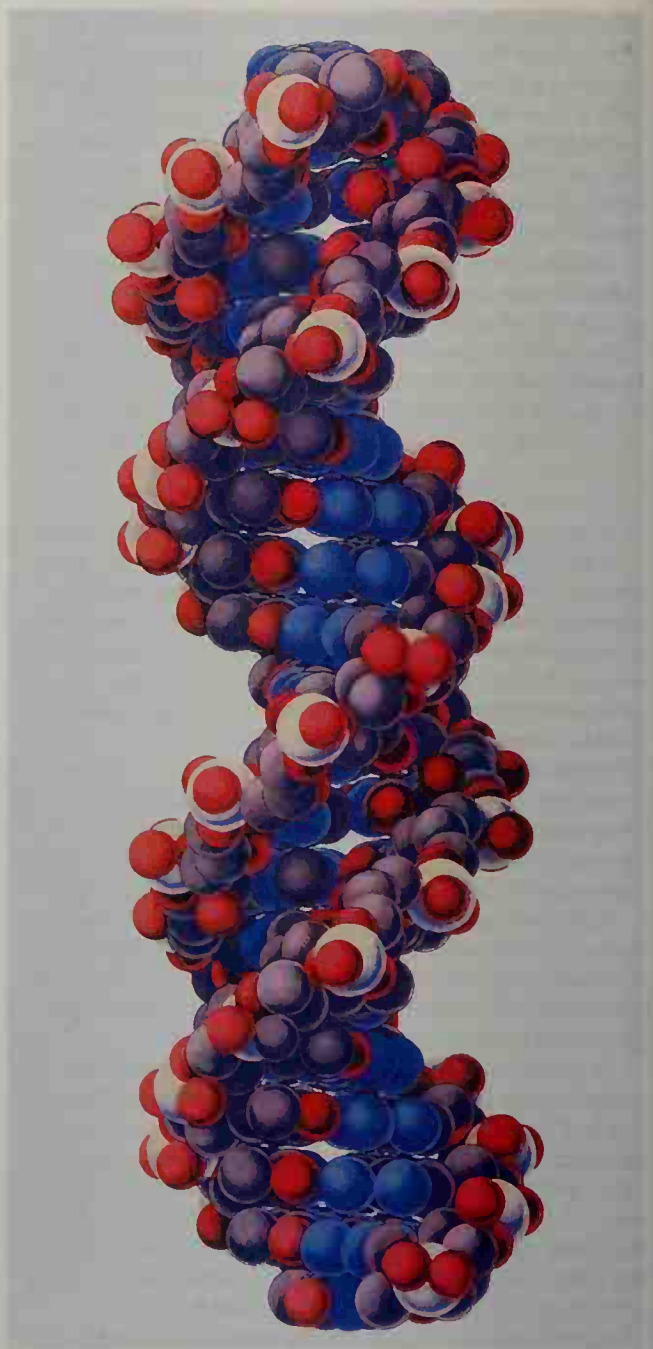
Replication. Most of the cells in your body divide from time to time. When you get a cut, for example, the skin cells around the wound begin to divide to make new skin to repair the damage. Each of the new daughter cells produced by cell division has the same DNA as the old cells. The process by which exact copies of DNA are made during cell division is called *replication*. The accurate replication of DNA is one of the essential characteristics of the hereditary material. Without it, daughter cells would be genetically different from each other and from the parent cell. Your genetic makeup, and therefore your physical characteristics, would be constantly changing as your cells divided.

The complementary nature of the two DNA strands enables a cell to make exact copies of its DNA. Before the cell divides, sections of the two original joined strands of a DNA molecule split lengthwise, separating the base pairs. This process is similar to what would happen if a ladder split down the middle, separating its rungs. Each of the DNA strands, which resembles a half ladder, then picks up free nucleotides from the cell nucleus. The bases in the free nucleotides, with their attached sugars and phosphates, pair with the matching bases on the original DNA strands. A's pair with T's, T's with A's, G's with C's, and C's with G's. In this way, two double-stranded DNA ladders are produced that have exactly the same base sequence as the parent DNA. When the cell divides, each of the new daughter cells receives identical DNA molecules.

How proteins are made. The *genetic code* is a code formed by the sequence of the bases in DNA. This code tells the cell how to put amino acids together in the right order to make a specific polypeptide.

A group of three bases in a certain order forms a unit of the genetic code called a *codon*. Most codons specify a certain amino acid. The order of codons on DNA determines the sequence of amino acids in a protein—and the protein product that is made.

A total of 64 three-letter codons, often called *triplets*, can be formed from the four letters of the DNA bases. Because there are only 20, not 64, amino acids, there is more than one codon for most amino acids. In addition, with only minor exceptions, the same three-letter codons specify the same amino acids in all organisms that have been studied. Therefore, the genetic code is nearly universal.



Ryland Loos from Francis H. C. Crick, the Salk Institute

A model of a DNA molecule shows that DNA is shaped like a twisted ladder. The colored spheres represent the various types of chemical units that make up DNA. This model was proposed in 1953 by biologists Francis H. C. Crick and James D. Watson.

Gene expression, the process by which the cell makes a protein according to the instructions carried by a gene, takes place in two steps. These steps are known as (1) *transcription* and (2) *translation*.

Transcription involves a close chemical cousin of

A *World Book* science activity

Studying heredity

The purpose of this activity is to study the interaction of heredity and environment in determining *phenotype*—that is, the observable characteristics—of organisms. The project looks at how various environmental factors influence the development of potato plants. *Eyes* (buds) that grow out of the same potato have the same *genotype*—that is, the same genetic makeup. Eyes can grow into new potato plants. By planting the eyes of a potato and changing such environmental conditions as light, water, and temperature, you can see how environmental factors influence characteristics.

What you need

An old potato with several eyes
A knife
Several wax paper or plastic cups
Potting soil, sand, water, plant food, and other materials you decide to use

WORLD BOOK illustrations by Mark Swindle

Activity procedure

Cut the potato so that each eye has about the same amount of potato attached to it.

Fill several of the wax paper or plastic cups with the same mixture of potting soil, sand, and water. (Potato plants grow best in slightly sandy soil and at temperatures that range from 60 to 70 °F [16 to 21 °C].)

Plant the potato pieces so the eyes are just above the surface of the soil. Provide one of the eyes with everything you think it needs to grow well, such as sufficient light and water. This eye will be your *control* for the experiment—that is, it will be the standard to which you compare the other eyes.

Alter one condition for each of the eyes other than the control. For example, place one of the eyes in a dark closet. Give one only half as much water as the others. Give another one plant food, following the directions on the package. Put one in the refrigerator to see how it is affected by the cooler temperature. Except for the one condition that you change for each plant, try to keep other environmental factors the same as much as possible. Label each container so you know which factor is different. Observe the eyes for several weeks to see how they grow. Keep a record of the plants' development. You may want to include drawings of the plants with this record.

Results and questions

After several weeks have passed, analyze the material you have collected. Are there differences in the way the individual plants have grown? Does any one environmental factor seem more influential than others in determining the plants' development? Do individuals with the same genetic makeup necessarily have the same observable characteristics? What relationship can you now conclude exists between genotype and phenotype?

Extending the activity

Think about genotype and phenotype in terms of human beings. Consider such factors as food and shelter as being part of a person's environment. Do you think you would look and act differently if you had the same genotype but grew up in another kind of home and ate different types of food? How would you be different? Can you think of other factors that are part of your environment?

DNA called *RNA (ribonucleic acid).* Like DNA, RNA is a nucleic acid and is composed of nucleotides. But the sugar in RNA is ribose instead of deoxyribose, and RNA contains the base *uracil* (U) instead of thymine. Like thymine, however, uracil base-pairs with adenine.

During transcription, a cell makes an RNA copy of one of the DNA strands of a gene. Part of the twisted DNA ladder unwinds and splits. One of the half ladders then serves as a *template* (mold) for lining up the RNA bases. The bases of the free nucleotides pair with the exposed DNA bases. For example, the RNA bases CUACAG pair with the DNA bases GATGTC. An RNA strand called *messenger RNA* (mRNA) is formed, and it is a complementary copy of the DNA blueprint.

As transcription proceeds, the mRNA copy of the gene peels off the DNA template. It then carries the instructions for making the gene's protein product to the cell's protein factories, which are structures known as *ribosomes.* The ribosomes are outside the nucleus in a part of the cell called the *cytoplasm.* The mRNA acts as a guide to line up the amino acids in the order called for by the gene, forming the correct protein chain.

Translation. In the translation step of gene expression, the ribosomes "read" the code in the mRNA and link amino acids in the order the mRNA codons dictate. Another type of RNA, called *transfer RNA* (tRNA), plays a key role in translation. Transfer RNA brings amino acids to the ribosomes from other parts of the cytoplasm.

A molecule of transfer RNA has two sites with important roles in translation. One site contains an *anticodon,* which consists of three nucleotides. The bases in the nucleotides of each tRNA anticodon are complementary to those in an mRNA codon and can therefore base-pair with them. The other site is at one end of the tRNA molecule. The tRNA binds to a specific amino acid at this site. For example, tRNA with the anticodon CGU binds to the mRNA codon GCA, which codes for the amino acid alanine. The end of the tRNA binds to alanine. Thus, this tRNA can deliver alanine to the ribosome.

The mRNA moves through a ribosome one codon at a time. After a codon arrives at the ribosome's decoding center, a tRNA molecule brings in the appropriate amino acid. In this way, the polypeptide grows, one amino acid at a time, until the ribosome reaches the end of the message in the mRNA. The last codon of the message signals that the chain is complete and tells the ribosome to stop production.

After the ribosome reads the stop codon, the finished polypeptide chain is released. The ribosome can then produce another polypeptide. In most proteins with more than one polypeptide chain, the chains are made separately. They then combine to make the protein.

History of the study of heredity

Early ideas about heredity. The Greek philosopher Aristotle (384-322 B.C.) proposed one of the oldest known theories of inheritance. He taught that traits are inherited through the blood. This theory was wrong, but it was generally accepted for more than 1,000 years.

A correct theory of inheritance could not be formulated until after sex cells had been discovered and their functions determined. The discovery of eggs and sperm occurred during the late 1600's. At that time, many biologists thought that either the egg or the sperm contained a tiny but fully formed embryo that merely increased in size inside the mother. During the late 1700's, Caspar Friedrich Wolff, a German scientist, proved embryos are not preformed. He showed that an embryo grows from a fertilized egg, and he argued that the sperm and the egg contribute equally to an embryo.

During the early 1800's, a French biologist and nobleman, the Chevalier de Lamarck, suggested that traits acquired during the lifetime of an organism could be passed on to its offspring. Later genetic discoveries showed that transmission of such acquired characteristics from one generation to the next does not occur.

However, Lamarck's theory was basically accepted by the British biologist Charles Darwin, who proposed the theory of natural selection in his book *The Origin of Species* (1859). Darwin believed each part of the body produced tiny particles that moved through the bloodstream into the eggs or sperm. These particles supposedly influenced hereditary traits. The British scientist Francis Galton, a cousin of Darwin's, disproved this idea. Galton transfused blood from black rabbits into white rabbits to see if the white ones would have black babies. But the white rabbits still produced white offspring.

Mendel's laws. In the mid-1800's, Gregor Mendel, an Austrian botanist and monk, conducted a series of experiments on inheritance. In his monastery garden, he studied traits in pea plants. These studies led Mendel to formulate the first correct theory of heredity. His theory had two principles called *Mendel's laws of heredity.*

Mendel's first law, the Law of Segregation, has three parts. (1) Hereditary characteristics are determined by separate units (now called genes). (2) These units occur in pairs. (3) The genes in a pair *segregate* (separate) during the division of sex cells, and each sperm or egg receives only one member of the pair.

Mendel's second law is called the Law of Independent Assortment. It states that each pair of genes behaves independently of all other pairs in the production of sex cells. Therefore, each gene pair is inherited independently of all other genes. Geneticists now know that independent assortment applies only to genes that are on different chromosomes or far apart on the same chromosome. Genes that are linked, or near each other on the same chromosome, tend to be inherited together.

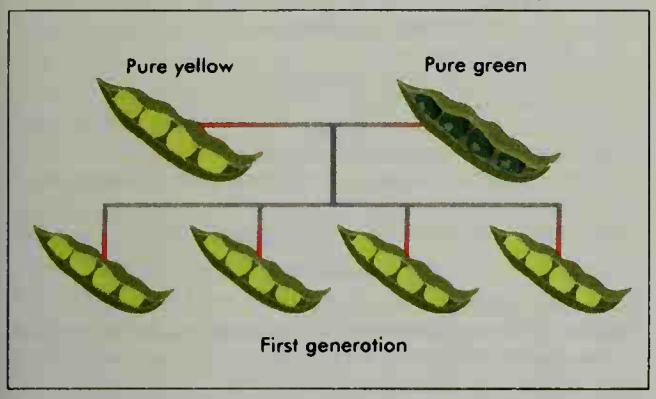
The birth of genetics. Mendel published a report of his work in 1866. But it went unnoticed until 1900. Then, three European botanists studying heredity each rediscovered Mendel's work. These three scientists were Hugo de Vries of the Netherlands, Carl Correns of Germany, and Erich von Tschermak of Austria. They conducted plant-breeding experiments and independently got results similar to those Mendel had obtained.

Many important genetic discoveries quickly followed the rediscovery of Mendel's principles. In the early 1900's, a group of scientists led by Thomas Hunt Morgan at Columbia University in New York City discovered many important aspects of heredity. These researchers included Calvin B. Bridges, Hermann J. Muller, and Alfred H. Sturtevant. Morgan and his team studied the inheritance of such traits as eye color and wing shape in fruit flies. They showed that genes were on chromosomes, made the first genetic map, demonstrated the inheritance of genes on sex chromosomes, and discovered crossing over. In 1931, the American geneticist Bar-

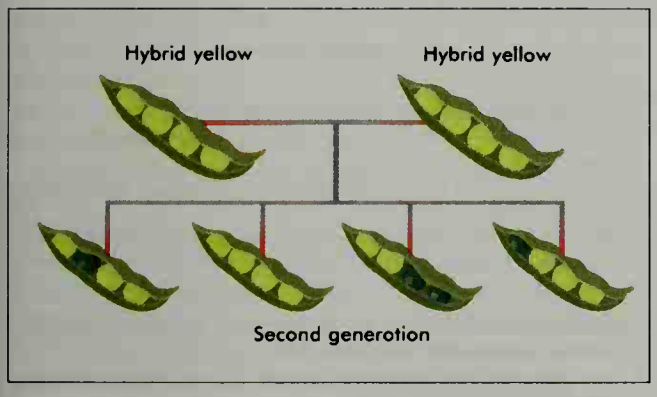
Mendel's experiments on heredity

In the mid-1800's, Gregor Mendel, an Austrian botanist and monk, studied traits in pea plants. The diagrams below show the main steps in Mendel's experiments on seed color.

WORLD BOOK diagrams by Mark Swindle



Mendel first experimented with purebred strains of pea plants—one with yellow seeds and one with green seeds. He crossed these strains, and all the resulting hybrid seeds were yellow. He concluded that yellow seed color was the dominant trait.



Plants grown from the hybrid yellow seeds produced yellow and green seeds in a ratio of about 3 to 1. The inheritance patterns Mendel discovered in this experiment and similar ones led him to formulate the first correct theory of heredity.

bara McClintock demonstrated that crossing over involves the physical exchange of chromosomal material.

The chemistry of genes was the focus of much genetic research after 1940. By the early 1950's, scientists had proved genes control chemical reactions in cells by directing the production of enzymes and other proteins. They had also found that DNA is the hereditary material.

Two scientists, James D. Watson of the United States and Francis H. C. Crick of the United Kingdom, proposed a model of the ladderlike chemical structure of DNA—the double helix—in 1953. Their model was a breakthrough because it suggested for the first time how DNA can be replicated faithfully. Watson and Crick suggested that DNA replicates by splitting down the middle and building two ladders by matching complementary halves. They also proposed that mutations result from a change in the sequence of bases along the ladder. In 1958, the American geneticists Matthew S. Meselson and Franklin Stahl demonstrated experimentally that DNA replicates just as Watson and Crick had proposed.

In 1961, scientists working at the California Institute of Technology reported their discovery of messenger RNA. That same year, the American biochemist Marshall W. Nirenberg and his colleagues at the National Institutes of Health (NIH) identified the first word of the genetic code—UUU. By 1967, the entire code had been broken.

The era of genetic engineering. Since the early 1970's, much of the study of heredity has involved the use of techniques called genetic engineering or recombinant DNA technology. Recombinant DNA technology alters genes in organisms to make molecules called *recombinant DNA.*

Scientists can produce recombinant DNA by first using enzymes called *restriction enzymes* to cut the chromosomal DNA from a plant or animal into pieces. They then make a recombinant DNA molecule by chemically attaching these smaller pieces to special DNA molecules called *vectors.* Vectors have the ability to enter cells and replicate. Next, scientists transplant the recombinant DNA into a bacterial or yeast cell. When these cells reproduce, researchers can obtain a huge number of identical cells that contain the recombinant DNA. A group of genetically identical cells is known as a *clone.*

Experiments with recombinant DNA have revealed much about gene structure and function. Recombinant DNA technology also has major medical applications. In 1982, genetically engineered insulin for diabetics became the first recombinant DNA drug approved by the United States Food and Drug Administration (FDA) for use on people. Other genetically engineered drugs followed. They include human growth hormone (hGH), which is used to treat children whose growth is seriously below average; *tissue plasminogen activator,* used to treat heart attacks by breaking up blood clots; and *interferon,* used to halt the spread of viruses from cell to cell.

Another important medical application of recombinant DNA technology is gene therapy. In 1990 and early 1991, researchers at the NIH used gene therapy on patients for the first time. They treated two young girls who had faulty genes for the enzyme *adenosine deaminase* (ADA). The genes produced a deficiency of the enzyme, which caused the girls to have severely weakened immune systems. The researchers used a modified virus to deliver a normal copy of the ADA gene to the girls. A few months after gene therapy, both girls had properly working immune systems. However, the therapy did not cure their condition, and the girls needed to receive periodic additional treatment. In 1993, NIH researchers tested gene therapy for the first time on a patient with cystic fibrosis, a hereditary disorder that causes a life-threatening build-up of thick mucus in the lungs.

By the mid-1990's, teams of geneticists had identified and cloned the genes that control several other serious genetic disorders. They include amyotrophic lateral sclerosis (ALS), Duchenne muscular dystrophy, and Huntington's disease.

Recombinant DNA technology has agricultural applications as well. Researchers are experimenting with using genetic-engineering techniques to improve certain features of crops, including flavor, shelf life, and the ability to resist diseases and pests.

In 1996, Scottish scientist Ian Wilmut and his coworkers cloned a sheep. They destroyed the nuclei of sheep egg cells and replaced them with nuclei from sheep udder cells. The egg cells were then placed into the uterus of a female sheep. One egg developed into a lamb named Dolly. Since Dolly had the same DNA as the

sheep that donated the udder cells, the two sheep were genetically identical. Using similar techniques, other geneticists cloned cows and mice in 1998. The cloning of mammals has raised the possibility of cloning humans.

The Human Genome Project. Geneticists from around the world launched the Human Genome Project in 1990. In June 2000, the project and Celera Genomics Corporation, a private company, announced that together they had determined essentially the entire sequence of the DNA bases in the human genome. In 2001, American and British scientists used these findings to determine that the human genome has about 30,000 to 40,000 genes, far fewer than previously believed. These researchers also found that humans share many genes with such primitive organisms as bacteria. In the future, scientists hope to develop highly detailed gene maps, showing where each gene lies in the human genome.

Human Genome Project geneticists have also obtained entire sequences of genomes for several smaller organisms. The sequence of the baker's yeast genome, including 6,000 genes, was reported in 1996. In 1998, geneticists determined the sequence of a species of roundworm. The genomes of several bacteria, including *E. coli,* have also been determined. Genome research has exciting applications, such as the search for genes that cause diseases. Finding such genes could enable scientists to better diagnose and cure disease.

Robert F. Weaver and Philip W. Hedrick

Related articles in *World Book* include:

Biographies

Beadle, George W.
Burbank, Luther
Crick, Francis H. C.
Darwin, Charles R.
De Vries, Hugo
Franklin, Rosalind E.
Galton, Sir Francis
Lamarck, Chevalier de
Lysenko, Trofim D.
McClintock, Barbara
Mendel, Gregor J.
Morgan, Thomas H.
Watson, James D.
Weismann, August
Wilkins, Maurice H. F.

Genetic basis of heredity

Amino acid
Cell (The work of a cell; The code of life)
Chromosome
DNA
Enzyme
Evolution (Causes of evolutionary change)
Gene
Mutation
Natural selection
Protein
RNA

Other related articles

Albino
Baldness
Behavior (Heredity)
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Brain (Genetic disorders)
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DNA fingerprinting
Dwarf
Environment
Eugenics
Fruit fly
Gene mapping
Gene therapy
Genetic counseling
Genetic engineering
Genetic testing
Genetics
Growth (How growth takes place)
Human Genome Project
Hybrid
Intelligence
Medicine (The challenge of genetics)
Mental illness (Genetic factors)
Molecular biology
Multiple birth
Plant (Factors affecting plant growth)
Races, Human (How human populations develop and change)
Radiation
Reproduction
Reproduction, Human
Rh factor
Sociobiology
Weight control (Heredity)

Outline

I. Chromosomes and genes
A. The structure of chromosomes and genes
B. Sex cells and reproduction
C. Chromosomes and sexual determination
II. Patterns of heredity
A. Dominant and recessive genes
B. Sex-linked genes
III. Sources of genetic variation
A. Mutation
B. Genetic recombination
IV. Heredity and natural selection
A. Natural selection
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V. Hereditary disorders
VI. Heredity and environment
VII. The flow of genetic information
A. Genes and proteins
B. The structure of DNA
C. How proteins are made
VIII. History of the study of heredity

Questions

What is the *genetic code?* A *codon?*
What are *X-linked genes?* Why do disorders caused by X-linked genes generally occur only in males?
How do DNA and RNA differ in structure?
What is the Human Genome Project?
What is the difference between a *genotype* and a *phenotype?*
Why is the complementary nature of DNA strands important?
What is *genetic engineering? Gene therapy?*
How does a crossing-over event occur?
What is a *germinal mutation?* A *somatic mutation?*
How does gene flow affect the makeup of a gene pool?

Additional resources

Level I

Beatty, Richard. *Genetics.* Raintree Steck-Vaughn, 2001.
Gardner, Robert. *Health Science Projects About Heredity.* Enslow, 2001.
Jacobs, Marian B. *Coping with Hereditary Diseases.* Rosen Pub. Group, 1999.
Judson, Karen. *Genetic Engineering: Debating the Benefits and Concerns.* Enslow, 2001.

Level II

Ackerman, Jennifer G. *Chance in the House of Fate: A Natural History of Heredity.* Houghton, 2001.
Cummings, Michael R. *Human Heredity: Principles and Issues.* 5th ed. Brooks/Cole, 1999.
Finkler, Kaja. *Experiencing the New Genetics: Family and Kinship on the Medical Frontier.* Univ. of Penn. Pr., 2000.

Hereford cattle. See Cattle (Hereford).

Heresy is a doctrine that conflicts with the accepted teachings of a religion or other authority. The term also refers to the holding of such a belief. *Heresy* comes from a Greek word that means *choose* or *prefer.* A person who believes in a heresy is a *heretic.* Many religious groups consider conscious heresy immoral and sometimes excommunicate heretics. A number of heretics have formed their own religious groups.

Some teachings have become heresies only after being rejected in favor of other teachings that became orthodox doctrine. For example, early Christians developed several interpretations of New Testament references to a Father, Son, and Holy Spirit. By the late 300's, church authorities officially accepted one interpretation, making the others heresies. For examples of Christian heresies, see Albigenses; Arianism; Gnosticism; Roman Catholic Church (Jansenism).

For centuries, civil and religious leaders tried to stamp out heresy. Many heretics were jailed, exiled, tortured, or executed. Today, some religious groups punish heretics by excommunicating them. Jill Raitt

See also Inquisition.

Heritage Foundation is a research and educational institution that formulates and promotes conservative

public policies. The principles of the foundation include the promotion of free enterprise, reduction of government regulation, lower taxes, decreased government size and expense, and a strong national defense.

The Heritage Foundation provides information on policy issues. It sends its findings to federal government officials, news media outlets, schools, and other organizations concerned with public policy. The Heritage Foundation publishes the bimonthly magazine *Policy Review: A Journal of American Citizenship.* It also publishes books and sponsors lectures and conferences. The foundation receives its funding from individuals, corporations, and other foundations.

Paul Weyrich and Edwin Feulner, two congressional aides, organized the Heritage Foundation in 1973. Joseph Coors, a Colorado businessman, provided initial financial support. The foundation's headquarters are in Washington, D.C. Carl L. Davis

Herman, Woody (1913-1987), was an American bandleader and musician. He ranks with Duke Ellington and Count Basie as one of the three most durable figures in the history of big-band jazz. Herman's bands made several musicians and composers famous, including saxophonists Stan Getz, Flip Phillips, Zoot Sims, and Al Cohn; trumpet players Sonny Berman and Pete Condoli; trombonist Bill Harris; and composers Neal Hefti and Ralph Burns. Herman also won praise playing alto saxophone and clarinet with his bands.

Herman's two most influential bands were known as the First Herd (1944-1946) and the Second Herd (1947-1948). Herman was one of the first bandleaders to use elements of a jazz movement of the 1940's called *bebop,* or *bop,* as well as classical music. The Russian-born composer Igor Stravinsky composed his *Ebony Concerto* (1946) for Herman's band. Herman developed an unusual reed section for the Second Herd consisting of three tenor saxophones and a baritone saxophone. The section was known for its bright, lyrical phrasing in such numbers as "Four Brothers."

Woodrow Charles Herman was born in Milwaukee. He formed his first big band, known as "The Band That Plays the Blues," in 1936. It became famous in 1939 with its recording of "Woodchoppers' Ball." Gary Giddins

See also **Jazz** (picture: Woody Herman).

Hermaphrodite, *hur MAF ruh dyt,* is an animal with both male and female organs of reproduction. Some flatworms and segmented worms are normally hermaphrodites, as are some echinoderms and mollusks.

Although some hermaphrodites fertilize their own eggs, most do not. Some show *successive hermaphroditism,* in which the two sets of organs produce eggs and sperm at different times. In others, the positions of the sex organs keep the animals from fertilizing themselves. For example, the common earthworm has active male and female organs located in different parts of the body. This allows two worms to fertilize each other, but prevents them from fertilizing themselves.

In the higher animals and human beings, hermaphroditism is not normal. The organs and functions of one or both sexes usually develop imperfectly in such rare individuals. Few human cases of hermaphroditism have been reported. Lawrence C. Wit

Hermes, *HUR meez,* was a god of fertility in Greek mythology. He was especially concerned with the sheep and goats raised by his principal worshipers, the people of the Arcadia region in southern Greece. In ancient Greek poetry, Hermes functioned as a messenger of the gods. Hermes was also a guide for souls to the underworld and for travelers. In addition, he was a protector of boundaries; a helper of heralds, speakers, traders, and thieves; and a bringer of good or unexpected luck. The Romans may have invented Mercury as an equivalent to Hermes (see Mercury).

Hermes was a son of Zeus, the king of the gods, and Maia, a minor goddess. His only important myth tells how, on the day of his birth, he invented fire and the lyre and stole the cattle of the god Apollo.

In art, Hermes was usually shown as a beardless youth wearing a broad-brimmed traveling hat and sandals, which were usually winged. He carried the *caduceus,* a winged staff entwined with snakes. The Greeks considered snakes symbols of fertility. F. Carter Philips

Hermit is a person who lives a solitary life, apart from social contact with others. Men and women become hermits for many reasons. They may want to avoid the evils or temptations they see in society. They may believe they can purify themselves by living alone. Or they may feel a special calling to a life of solitude.

Hermits give up comfort, family, marriage, property, and pleasure for chastity, fasting, meditation, and silence. They train themselves to eat simply, infrequently, and in small amounts. Hermits seldom see or talk to visitors. But people who want spiritual guidance or physical healing sometimes seek them out, sometimes driving hermits to search for even more secluded places.

Religious hermits are commonly regarded as holy persons. They have played important roles in forming the religious disciplines of Buddhism, Christianity, Hinduism, Islam, and Taoism. Religious hermits have withdrawn to caves, cells, holes, pillars, and tombs. They may live in deserts, forests, ravines, or even in cities.

In some religions, particularly Buddhism and Christianity, there were hermits who joined others in forming hermitages. In a hermitage, a number of hermits live in separate cells or rooms and follow religious disciplines. They have few social contacts. Monasteries are sometimes related to hermitages. In monastic communities, monks form self-sufficient social groups and set aside certain times for solitary meditation and prayer.

Anyone may want to be alone and silent for a time to think seriously, pray, work, or prepare for some special event. Hermits find this experience so rewarding that it becomes a way of life for them. Anne E. Carr

See also **Asceticism; Monasticism.**

Hermit crab is an animal best known for its habit of occupying the empty shell of a snail. The crab uses the shell to protect its soft abdomen, which it twists into the shell. A pair of small modified limbs at the end of the abdomen grip the interior of the shell tightly. The other walking legs and the claws are covered with a hard, thick material called *chitin* and usually remain outside the shell. In some cases, a hermit crab can withdraw completely into the shell. It seals off the shell's opening with one or both claws.

As hermit crabs grow, they exchange their shells for larger ones. A crab usually finds an empty shell to occupy, but it will pull a snail from a shell if necessary. Hermit crabs compete with each other for empty shells

in areas where the shells are scarce. Some species occupy holes in small pieces of coral, rock, or wood instead of shells.

Marine hermit crabs often crowd the ocean floor in areas where food and snail shells are abundant. They also live along the seashore in pools left by the retreating tide. Other kinds of hermit crabs spend most of their lives on shore. They often occupy the shells of land snails. One type of land hermit crab is called the *coconut crab* or *robber crab* because it feeds on the meat of coconuts. Adult coconut crabs do not occupy shells. In these crabs, the abdomen is curled under the rest of the body.

Scientific classification. Hermit crabs belong to the subphylum Crustacea in the phylum Arthropoda. They make up the hermit crab family, Paguridae. Jonathan Green

See also Animal (picture: A hermit crab's home).

Herndon, William Henry (1818-1891), an American lawyer, was the law partner of Abraham Lincoln. He is known chiefly for his collection of letters to and from Lincoln's contemporaries. These letters give valuable information on Lincoln's life and times.

Herndon was born in Greensburg, Ky. He was educated at Illinois College in Jacksonville. He became a crusading abolitionist and, at 25, Lincoln's law partner. Herndon published *Life of Lincoln* with Jesse Weik in 1889. Mark E. Neely, Jr.

Herne, *hurn,* **James A.** (1839-1901), was an American playwright, actor, and theater manager. He is best known for two plays that were well in advance of their time in their realistic treatment of serious social problems. *Drifting Apart* (1888) probes the consequences of man's slavery to drink. *Margaret Fleming* (1890) is an outspoken treatment of an unfaithful husband and his forgiving wife. The plays were praised by such literary figures as William Dean Howells and Hamlin Garland, but they shocked the theater public of the day.

Herne's *Hearts of Oak* (1879), *Shore Acres* (1892), and *Sag Harbor* (1899) were warm-hearted and realistically detailed plays tailored to the American tastes of the time. Herne was born in Cohoes, N.Y. His real name was James Ahern. Frederick C. Wilkins

Hernia, *HUR nee uh,* also called *rupture,* results from a break in cavity walls within the body. Many organs of the body, like the lungs, heart, or intestines, are inside hollow places called *body cavities.* Sometimes the wall of a cavity breaks, or ruptures, and part of the organ pushes through. Then the person has a hernia.

When used alone, the word *hernia* generally means an *abdominal hernia.* In this type of hernia, a loop of the bowel sticks out through the muscular wall of the abdomen. The hernia often occurs at a weak point of the muscular wall. It usually pushes out a part of the inner lining of the abdomen, the *peritoneum,* and forms a *hernial sac.* This sac may be felt or seen underneath the skin of the abdomen.

The danger of abdominal hernia is that the abdominal muscles may contract, *strangulating* (choking off) the part of the bowel that protrudes. Doctors usually operate immediately on persons with this condition. Supports such as trusses may relieve abdominal hernias by keeping the bowel inside the abdominal wall. But the only cure for a hernia is an operation.

In *hernia cerebri,* a portion of the brain protrudes through an opening in the skull. Hernia may also occur in various other internal organs, such as the bladder.

Hernia results from many causes. An abdominal hernia sometimes results from lifting a heavy object, or from a strain or other injury. Bruce Reider

Hero. See **Invention** (Ancient Greece); **Steam engine** (History).

Hero and Leander, *lee AN duhr,* were legendary Greek lovers. Hero was a priestess of the goddess Aphrodite at Sestos in Thrace. Leander lived at Abydos across the Hellespont, or Dardanelles. Every night, Hero put a light in her tower, and Leander swam across the water to visit her. He returned to Abydos at dawn. One stormy night, the wind put out Hero's light, and Leander was overwhelmed and drowned. At dawn, Hero saw Leander's body floating beneath her tower. In her grief, she leaped into the sea and drowned herself.

William F. Hansen

Herod, *HEHR uhd,* was the name of a ruling family in Palestine during the 100's B.C. and the first 100 years after Christ's birth, while Palestine was part of the Roman Empire.

Herod the Great (about 73-about 4 B.C.) ruled all of Palestine as king of Judea from 37 B.C. until his death. Throughout his reign, he put down plots against his leadership by killing anyone suspected of threatening his throne. The executions included three of his sons and several other family members. His ruthlessness is illustrated in the story of the slaughter of the infant boys in and around Bethlehem (Matt. 2). Herod ordered their deaths in an attempt to kill the infant Jesus (see **Jesus Christ** [The Nativity]).

Herod began a widespread building program in Palestine. In Jerusalem, he built a theater and a palace, rebuilt the fortress, and began rebuilding the Jewish Temple. He also built or rebuilt many other fortresses, including Masada (see Masada). In addition, he constructed the seaport of Caesarea.

After Herod's death, three of his sons inherited his kingdom. Herod Archelaus ruled Judea until A.D. 6, when he was deposed for misrule. Herod Philip governed northeastern Palestine until his death in A.D. 34. Herod Antipas inherited Galilee and Perea.

Herod Antipas (?-A.D. 40), son of Herod the Great, governed Galilee and Perea until he was deposed in A.D. 39. Like his father, Antipas maintained his power by threats and by eliminating his enemies. The popular movement of Saint John the Baptist threatened the stability of his rule. Thus, Antipas arrested John and had him beheaded (see **John the Baptist, Saint**). Antipas apparently planned to execute Jesus when Jesus' following also became a threat (Luke 13:31).

Antipas continued the building program begun by Herod the Great. His greatest project was construction of a city, Tiberius, on the shore of the Sea of Galilee.

Herod Agrippa I (10 B.C.-A.D. 44), grandson of Herod the Great, began ruling northeastern Palestine in A.D. 37. In A.D. 39, he received Galilee and Perea, formerly the territory of Herod Antipas. Agrippa I helped Claudius become emperor of Rome in A.D. 41. In reward, Claudius added Judea and Samaria to Herod's kingdom.

Agrippa I sought to gain the favor of his Jewish subjects and, as a result, he persecuted the Christian community in Jerusalem (Acts 12). He was a harsh ruler who

could angrily attack anyone who opposed him.

Herod Agrippa II (A.D. 27-100) was the son of Herod Agrippa I. He became king of Chalis, a small territory in what is now Lebanon, in A.D. 50. In A.D. 56, he received Galilee and Perea from the Roman Emperor Nero. At the request of the Roman governor Festus, Agrippa II heard the apostle Paul's speech defending himself against accusations from Jewish leaders (Acts 23-26).

Agrippa II tried to prevent the Jewish revolt against Rome, but he failed. When war broke out in A.D. 66, he sided firmly with the Romans. M. Robert Mulholland, Jr.

Herodotus, *hih RAHD uh tuhs* (484?-425? B.C.), was the first Greek historian. He is famous for the nine books he wrote on the rise of the Persian Empire, the Persian invasions of Greece in 490 and 480 B.C., the heroic fight of the Greeks against the invaders, and the final Greek victory. Herodotus saw the wars between Persia and Greece as part of a series of struggles between Eastern monarchies and the West. Cycles of happiness and misery for states and individuals play an important part in his historical accounts. Herodotus thought that the gods used such cycles to punish human pride.

Herodotus was born at Halicarnassus, in Asia Minor (now Turkey). During his youth, he traveled widely in Greece, the Middle East, and North Africa. Everywhere he went, he studied the manners, customs, and religions of the people, and learned as much as he could of their history. The things Herodotus learned in his travels formed the materials of his histories. Although he questioned the accuracy of many of the stories he repeated, scholars have confirmed much of his information.

In about 447 B.C., Herodotus visited Athens, and three years later settled in the colony of Thurii, which Pericles was then founding in southern Italy. It has been said that Herodotus died and was buried at Thurii. For a quotation from Herodotus, see **Postal services** (Ancient times). Howard B. Wolman

See also **History** (The ancient Greeks and Romans).

Heroin, *HEHR oh ihn,* is a drug made from morphine, an active chemical in opium. Like morphine, heroin relieves pain and brings sleep. But because heroin is stronger and more habit-forming than morphine, it is not used for medical purposes. The government of the United States forbids the manufacture, importation, and use of heroin, but many people obtain it illegally. Heroin has several nicknames, including "H," "horse," and "smack."

Drug addicts use heroin by eating it, by *snorting* (sniffing it), by *skin popping* (injecting it under the skin), by *muscling* (injecting it into a muscle), or by *mainlining* (injecting it into a vein). To addicts, heroin offers escape from a seemingly intolerable existence by providing a feeling of joy and relief. In time, the repeated use results in physical and psychological dependence on the drug.

If an addict stops taking heroin, he or she suffers such withdrawal symptoms as body aches, diarrhea, muscle cramps, or nausea. The intensity of these symptoms peaks in 2 to 3 days and then gradually decreases over 7 to 10 days. Addicts who suddenly resume taking heroin in the same amounts they took previously risk having a fatal overdose. The addict's chief goal is getting more heroin. Many addicts turn to crime—particularly theft or prostitution—to get the large amounts of money needed to buy the drug.

Many addicts do not eat nourishing foods or maintain personal cleanliness. Also, the needle used to inject the drug is often unsterile. Such neglect can result in AIDS, hepatitis, malnutrition, pneumonia, or skin infections. Babies born to mothers addicted to an opium-based drug are physically dependent on the drug and have to undergo withdrawal treatment.

Most addicts have severe personality problems. Programs offering treatment and rehabilitation for addicts have been developed in many countries.

Donald J. Wolk

See also **Drug abuse; Morphine.**

Heron, *HEHR uhn,* is any of about 60 species of wading birds, including egrets and bitterns. Herons are graceful birds with long, pointed bills that seem to extend right into their eyes. Most herons have narrow heads, long slender necks, and sticklike legs that are similar to the legs of cranes and storks. Some herons have long crests and plumes on their throats and bodies. Herons live on all continents except Antarctica.

Habits. In flight, herons stretch their long legs straight out behind them and curl their heads between their shoulders. Cranes, storks, and ibises fly with their necks extended. Herons usually nest and roost in flocks, but they hunt food alone. Their nesting places are called *heronries.* The nests consist of loose, crude masses of sticks built in treetops or in bushes. The female lays three to six eggs. Young herons are helpless for a few weeks after they hatch. Their parents carry food to the young birds until they can fly.

Hal Harrison from Grant Heilman

The great blue heron, *shown here,* is the largest American heron. It uses its long, pointed bill to catch fish.

Ron Austing, Bruce Coleman Inc.

Green-backed herons, *above,* build nests of sticks in trees or tall shrubs. Most of these birds live near water.

In search of food, the heron wades along the shores of streams with a stately stride, silent and alone. Sometimes the bird may stand for a long time with its head drawn between its shoulders. It appears to be asleep, but it is patiently waiting for fish, frogs, crayfish, and other small animals. As soon as it sees its prey, the heron makes a lightning dart and catches the victim in its spearlike bill.

American herons. The largest American heron is the *great blue heron.* It lives throughout much of North America. Some species of herons have two color forms, one of which is white. The *great white heron* is actually the white color form of the great blue heron. The *green-backed heron* and the *Louisiana heron* are colorful species that lack white forms.

Scientific classification. Herons belong to the heron family, Ardeidae. The scientific name for the great blue heron is *Ardea herodias.* The green-backed heron is *Butorides striatus,* and the Louisiana heron is *Egretta tricolor.* Eric G. Bolen

See also Bittern; Crane; Egret.

Herpes, *HUR peez,* **Genital,** is the name of a widespread sexually transmitted disease. It is also known simply as *herpes.* Genital herpes is caused by the *herpes simplex virus, type 2 (HSV-2).* HSV-2 is one of the *herpesviruses,* a group of viruses that cause a wide variety of diseases. See Herpesvirus.

HSV-2 infects only human beings and is transmitted during intimate sexual activity. In most cases, infection occurs on or around the sex organs or rectum. The virus then spreads along the nerves that connect the infected area to the central nervous system. The virus may be present in the body without producing signs of illness. An infected person also may experience symptoms that go away, only to reappear months or years later.

Symptoms include fever, headache, stiffness in the neck, and weakness. Within one to three weeks after infection, a small pimple develops at the site of infection. The pimple rapidly becomes a blister, which then develops into an open, painful sore called an *ulcer.* Other blisters appear, accompanied by painful urination and itching. Women may experience discharge from the vagina. The ulcers last 4 to 15 days, then gradually crust over and heal. Sores may recur up to several times a year. During these times, the blisters and ulcers heal more rapidly and are less painful.

In people with AIDS, symptoms of genital herpes can be particularly severe, involving persistent, painful ulcers that last for months. The symptoms worsen as AIDS progresses and become very difficult to control.

A pregnant woman who has genital herpes may pass the infection to her baby during the birthing process. Infection in the newborn may spread throughout the body, leading to blindness, brain damage, or death.

Doctors usually diagnose genital herpes by recognizing symptoms of the disease. Blood tests can identify the infection in cases where symptoms are not present. Doctors prescribe the drug acyclovir in treating genital herpes. In most cases, this drug reduces the severity of the symptoms and prevents or decreases the frequency of recurrences. Individuals may reduce the risk of infection with genital herpes by using condoms or other protective measures during sexual activity. Ronald K. St. John

See also Sexually transmitted disease.

Herpesvirus, *HUR peez VY ruhs,* is the name of a group of viruses that cause a wide variety of diseases. Genital herpes, a widespread sexually transmitted disease, is caused by a herpesvirus. Herpesviruses also cause such conditions as chickenpox, cold sores, mononucleosis, and shingles.

Herpesviruses may be present in the body without producing signs of illness. People infected with certain herpesviruses may experience symptoms that go away, then reappear months or years later. The viruses are spread through direct physical contact with an infected person. Ronald K. St. John

Related articles in *World Book* include:

Chickenpox	Herpes, Genital
Cold sore	Meningitis
Encephalitis	Mononucleosis
Epstein-Barr virus	Shingles

Herpetology, *HUR puh TAHL uh jee,* is the branch of zoology concerned with the study of reptiles and amphibians. The name *herpetology* comes from the Greek word *herpeton,* meaning *crawling thing.* Herpetologists study such animals as snakes, lizards, crocodiles, frogs, and salamanders. Herpetologists have made important contributions to many areas of biology, including ecology, evolution, and animal behavior. See also **Amphibian; Reptile.** Laurie J. Vitt

Herrera, *eh RAY rah,* **Tomás,** *toh MAHS* (1804-1854), was a soldier and statesman of Panama. He led the movement in 1840 to make Panama independent of Colombia. He was president of the Free State of Panama for the year that it existed, and later held high office in Co-

lombia. Herrera was born in Panama City. In 1854, he put down a revolt in Colombia, and was killed leading his army into Bogotá. Steve C. Ropp

Herrick, Robert (1591-1674), was one of England's finest lyric poets. He is best known for his love lyrics to imaginary ladies and graceful poems about nature and English country life. Herrick celebrated the earthy joys of rural life in such poems as "The Argument of His Book" and "To Daffodils." In "To the Virgins, to Make Much of Time," he cleverly adapts the New Testament parable of the 10 virgins to the classical theme of *carpe diem* ("seize the day"). The poem contains the famous line "Gather ye rosebuds while ye may." Herrick's lyric poetry reflects the influence of Roman poets and the English poet and playwright Ben Jonson. Herrick's well-known poem "Corinna's Going A-Maying" ends with an urgent reminder of human mortality in the lines:

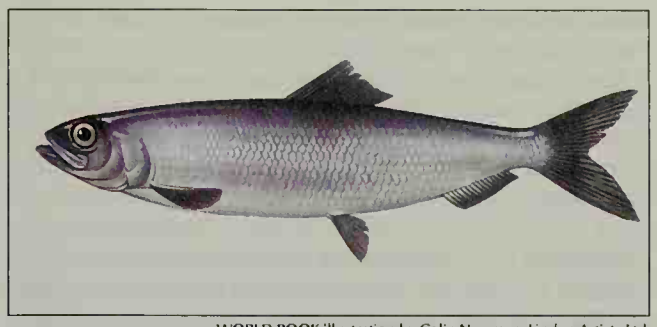
Come, let us go, while we are in our prime,
And take the harmless folly of the time!
We shall grow old apace, and die
Before we know our liberty.
Our life is short, and our days run
As fast away as does the sun.
And as a vapour or a drop of rain,
Once lost, can ne'er be found again:
So when or you or I are made
A fable, song, or fleeting shade,
All love, all liking, all delight
Lies drowned with us in endless night.
Then, while time serves, and we are but decaying,
Come, my Corinna, come, let's go a-Maying.

Herrick was born in London. He was ordained in the Church of England in 1623 and served as a *vicar* (minister of a parish) in the rural county of Devonshire (now Devon). Herrick's poems were widely known in manuscript form before being published in the collection *Hesperides* (1648). The volume includes a section of religious poetry called *Noble Numbers*. Gary A. Stringer

Herring is one of the most important food fish in the world. Europeans use it more widely than Americans. It belongs to the herring family, which also includes the shad, menhaden, sardine, and alewife. Herring abound along the seacoasts of the temperate and colder parts of the North Pacific and North Atlantic oceans, and in inland lakes. The Atlantic herring is one of the most numerous of all backboned animals. Overfishing of herring in the North Sea made breeding stock begin to decline greatly in the 1970's. Several countries then took steps to restrict herring fishing in North Sea waters. By the mid-1980's, herring breeding stock began to increase.

Appearance and habits. Herring have thin scales colored blue-green to blackish above, brilliant silver on the sides, and white below. Both jaws have small teeth. Small crustaceans are the herring's chief source of food. Millions of herring swim close together near the surface of the water, in areas ranging from 6 to 20 square miles (16 to 52 square kilometers).

Herring spend part of the time in deep water, then migrate to shallower coastal waters where they lay their eggs. A female deposits from 20,000 to 185,000 eggs, depending on her size. The eggs settle to the bottom, where they cover seaweed and rocks. Within a few weeks, the eggs hatch. Herring have many enemies. In spite of the number of eggs which are laid, few develop into adult herring. Crabs and such fish as haddock eat many of the eggs and young. The adult herring are eaten by other creatures of the sea, such as whales and seals, and by gulls and other birds.



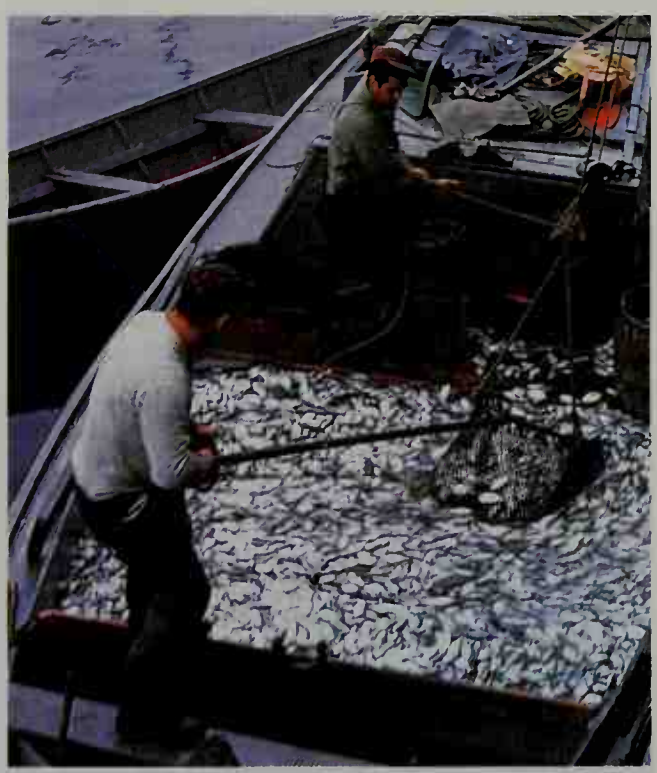
WORLD BOOK illustration by Colin Newman, Linden Artists Ltd.

Pacific herring inhabit the ocean's northern waters.

Commercial fishing. Fishing crews find the great schools of herring, called shoals, by watching for the many sea birds that hover over the schools, and by the light, or luminescence, caused in the seawater by the swimming herring. Some boats now detect the schools by devices similar to those used for detecting submarines during wartime.

Herring are usually caught in large nets. A fishing crew goes to a spot where a large number of herring are seen and lets an immense net out. The crew then rows along the edges of the net in small boats and forces the mass of fish nearer the center. Then, the fishing boat approaches and many thousands of herring are raised in the net and thrown into the boat.

Norway, Canada, Sweden, Denmark, and Iceland are the leading countries in the harvest of Atlantic herring.



E. R. Degginger

Herring fishermen bring in a large catch of the fish from the Atlantic Ocean, near Cape Cod. Herring is one of the most important food fishes in the world.

Russia and the United States have the largest annual catches of Pacific herring.

Uses. Many herring are frozen and used for bait in the halibut and cod fisheries. Industry makes millions into fertilizer, and uses the oil extracted from them to lubricate machinery and for other purposes.

In many parts of the world, herring are a favorite food, either pickled, smoked, or eaten fresh. Herring which have been smoked but not salted are known in England as *Yarmouth bloaters.* Those similarly prepared, but also split and cleaned, are called *kippered herring.* They are canned in Scotland and Norway and sent to America, where they are one of the most popular forms of herring. Small herring are often put into tins and sold as *whitebait.* Pickled herring are put into brine, sometimes with onions and spices. They are sold either *round* or *split.* Round herring are salted whole. Split herring have the gills, heart, and other parts removed.

Scientific classification. Herring are members of the herring family, Clupeidae. The Atlantic herring is *Clupea harengus.* The Pacific herring is *C. pallasii.* Robert R. Rofen

See also Alewife; Fish (picture: Fish of coastal waters and the open ocean); Menhaden; Sardine; Shad.

Herriot, James (1916-1995), was the pen name of James Alfred Wight, a British veterinarian and author. He became known for stories based on his work as a country veterinarian. Many of the stories are collected in the books *All Creatures Great and Small* (1972), *All Things Bright and Beautiful* (1974), *All Things Wise and Wonderful* (1977), and *The Lord God Made Them All* (1981).

Herriot was born in Glasgow, Scotland. After graduating from Glasgow Veterinary College in 1937, he set up a practice in the county of North Yorkshire, England. Herriot traveled from farm to farm caring for cows, horses, and sheep. His experiences with both animals and people became the basis for his writings.

Herriot began writing at the age of 50. His *James Herriot's Yorkshire* (1979) includes photographs and descriptions of the rural area that forms the setting for his books. Deborah A. Behler

Herschel, *HUR shuhl,* **Caroline Lucretia** (1750-1848), was the first noted woman astronomer. She assisted her brother, the astronomer Sir William Herschel, in his observations and in 1786 independently discovered a comet. She later discovered seven more comets. She also located a number of hazy objects called *nebulae,* including the companion of the Andromeda nebula. In 1828, the Royal Astronomical Society presented her with a gold medal for her catalog of William Herschel's observations of nebulae and stellar systems.

Herschel was born in Hanover, Germany. In 1772, she joined her brother in England, where their work together began. Michael J. Crowe

Herschel, *HUR shuhl,* **Sir John Frederick William** (1792-1871), was a noted British astronomer. He won prominence for his varied contributions to science.

Herschel was born near London in Slough, England. His father, Sir William Herschel, was a famous astronomer. The younger Herschel graduated from Cambridge University in 1813. He carried on his research after graduation, publishing works on mathematics and optics. His discovery that *sodium thiosulfate* (hypo) dissolves silver salts contributed to the development of photography.

From 1834 to 1838, Herschel surveyed the southern skies as thoroughly as his father had studied the northern heavens. He discovered over 1,200 double stars and an even larger number of star clusters and hazy objects called *nebulae.* He also charted the Magellanic Clouds, two galaxies visible in the Southern Hemisphere. He was a founder of England's Royal Astronomical Society. Herschel published the results of his observations at the Cape of Good Hope in 1847. His other publications include *Outlines of Astronomy* (1849) and *General Catalogue of Nebulae* (1864). Michael J. Crowe

Herschel, *HUR shuhl,* **Sir William** (1738-1822), was a British astronomer who founded *stellar astronomy,* the study of the region beyond the solar system. He was the first astronomer to observe that many indistinct objects in the heavens are star systems similar to the Milky Way. Herschel discovered over 2,500 such objects and more than 800 double stars. He used telescopes he built. The mirror of one of these had a diameter of 4 feet (1.2 meters). It was the largest telescope until 1845.

In 1781, Herschel discovered the planet Uranus. He later found two satellites of Uranus and two satellites of Saturn. His other achievements include pioneering studies of the sun's motion through space, of the relative brightness of stars, and of infrared rays.

Herschel was born in Hanover, Germany. He settled in England in 1757. His sister Caroline and his son, John, were also astronomers. Michael J. Crowe

Hersey, *HUR see,* **John** (1914-1993), an American novelist and journalist, became famous for his works about World War II. He won a 1945 Pulitzer Prize for *A Bell for Adano.* This novel describes the impact of American soldiers occupying an Italian village. Hersey's best-known nonfiction work, *Hiroshima* (1946), portrays the destruction of the Japanese city of Hiroshima by an atomic bomb. A new edition of the book was published in 1985.

Hersey was born in Tianjin, China, where his parents were missionaries. He was a war correspondent during World War II. His first book, *Men on Bataan* (1942), tells his observations of the war. Hersey also wrote *The Wall* (1950), *The Child Buyer* (1960), *The Algiers Motel Incident* (1968), *The Conspiracy* (1972), *The Call* (1985), and *Blues* (1987). Bert Hitchcock

Hershey, Milton Snavely (1857-1945), was an American manufacturer and philanthropist who founded one of the world's largest confectionery companies, the Hershey Chocolate Company. He was a pioneer in the mass production of milk chocolate, turning it from an expensive luxury into an affordable, everyday treat.

Hershey was born in Derry Church, Pennsylvania. He became a confectioner's apprentice in nearby Lancaster at age 15. After several failures, he founded his first successful business, the Lancaster Caramel Company, in 1886. He created the Hershey Chocolate Company in 1894 to make chocolate coatings for his caramels. He soon perfected a formula for milk chocolate and, in 1900, the company began selling the "Hershey bar." Also in 1900, he sold his caramel company for $1 million.

Hershey began to build a factory in Derry Church in 1903, and his company began operating there in 1905. The community was renamed Hershey in 1906. There, Hershey and his wife Catherine set up what became the Milton Hershey School for disadvantaged children in 1909. In 1918, he placed most of his fortune in trust for the school. James D. McMahon, Jr.

Hertz, *hurts,* is the unit used to measure the *frequency* (rate of occurrence) of periodic waves and vibrations. Its symbol is *Hz.* Periodic waves are made by objects whose vibrations repeat at regular intervals. Such objects include tuning forks, human vocal cords, and radio transmitters. A wave's frequency is the number of complete *cycles* (vibrations) that occur each second. One hertz equals one cycle per second. The musical note "A" has a frequency of 440 Hz or 440 cycles per second. Radio waves may have frequencies of many million hertz.

The hertz was adopted in 1960 by an international group of scientists at the General Conference of Weights and Measures. It was named for Heinrich R. Hertz, a German physicist. Bruce F. Field

See also **Hertz, Heinrich R.; Sound** (Frequency and pitch); **Waves.**

Hertz, *hurts* or *hehrts,* **Gustav,** *GUS tahf* (1887-1975), a German physicist, shared the 1925 Nobel Prize for physics for proving the validity of Niels Bohr's theory of the atom (see **Bohr, Niels**). In 1932, Hertz developed a way of separating forms of chemical elements called *isotopes* (see **Isotope**). The United States government uses his process in its uranium separation plants. Hertz was born in Hamburg. He received a doctorate from the University of Berlin in 1911. Hertz worked in the Soviet Union from 1945 to 1954. David Cassidy

Hertz, *hurts* or *hehrts,* **Heinrich Rudolph,** *HYN rihkh* (1857-1894), was a German physicist. He opened the way for the development of radio, television, and radar with his discovery of electromagnetic waves between 1886 and 1888. James Clerk Maxwell had predicted such waves in 1864 (see **Maxwell, James Clerk**). Hertz used a rapidly oscillating electric spark to produce waves of ultrahigh frequency. He showed that these waves caused similar electrical oscillations in a distant wire loop. He also showed that light waves and electromagnetic waves were identical (see **Electromagnetism**). Hertz was born in Hamburg. Richard G. Olson

Hertzog, *HEHRT sawk,* **James Barry Munnik** (1866-1942), served as South Africa's prime minister from 1924 to 1939. Under his leadership, the country's Parliament passed laws that became part of the foundation of *apartheid,* the policy of racial segregation adopted by the government in 1948.

Hertzog was born in Cape Province, into a Boer family. Now known as *Afrikaners,* Boers were whites whose ancestors came mainly from the Netherlands, Germany, and France. They spoke Afrikaans, a language related to Dutch. Many other white South Africans were of British descent. Hertzog fought the British in South Africa as a general in the Boer War (1899-1902). In 1914, he founded the National Party (now the New National Party) to fight for Boers' rights. During his prime ministership, Parliament made Afrikaans one of South Africa's official languages, in addition to English. It also reserved many jobs for whites, helped exclude blacks from ownership of nearly 90 percent of South Africa's land, and prohibited blacks from directly participating in the government. Nancy L. Clark

See also **Boer War; South Africa** (The rise of Afrikaner nationalism).

Herzberg, Gerhard (1904-1999), a Canadian physicist, won the 1971 Nobel Prize in chemistry for determining the electronic structure of molecules. His studies played an important part in such fields as astrophysics, physical chemistry, and quantum mechanics.

Herzberg devoted his career to the *spectroscopy* of atoms and molecules—that is, the observation of radiation that atoms and molecules emit when excited. Such study reveals the structure of atoms and molecules. Herzberg determined the structures of the molecules of many substances.

Herzberg was born in Hamburg, Germany, and graduated from the Darmstadt Institute of Technology in 1928. He moved to Canada in 1935 and became a Canadian citizen in 1945. In 1955, Herzberg became the director of the Division of Pure Physics of the National Research Council of Canada. Richard L. Hilt

Herzegovina. See **Bosnia-Herzegovina.**

Herzen, *HEHRT suhn,* **Alexander Ivanovich** (1812-1870), was a Russian journalist and one of the best-known revolutionaries of his day. He was born in Moscow on April 6, 1812, and graduated from Moscow State University. Twice arrested and exiled from Moscow for antigovernment activities, Herzen left Russia in 1847 and never returned. He settled in London in 1852. From 1857 to 1867, Herzen published the newspaper *Kolokol* (*The Bell*). The newspaper, which criticized the Russian government, and Herzen's other writings influenced reforms in Russia such as freeing the serfs. Although officially banned, *Kolokol* was very popular in Russia, even among government officials. His works include *From the Other Shore* (1850), a collection of articles; and *My Past and Thoughts* (1852-1855), a six-volume autobiography. Herzen died on Jan. 21, 1870. Donald J. Raleigh

Herzl, *HEHR tsuhl,* **Theodor,** *TAY aw DOHR* (1860-1904), was an Austrian journalist and playwright and the chief leader of the Zionist movement. The movement's aim was to set up a Jewish national home in Palestine (see **Zionism**). Herzl was born in Budapest, Hungary.

The growing problem of anti-Jewish feeling in Europe, increased by the Dreyfus case in France, attracted Herzl's attention (see **Dreyfus affair**). He saw that European Jews had failed to gain social equality even when they had become politically free. So Herzl got the idea of gathering the scattered Jews into a country and a nation of their own. His motives were economic and social, rather than religious. Herzl's *Jewish State,* published in 1896, attracted many people to the Zionist cause, including Max Nordau and Israel Zangwill. In 1897, Herzl presided over the first Zionist congress in Basel, Switzerland. In 1901, the United Kingdom offered the Jewish people land in British East Africa. Worry about the dispute over this offer injured Herzl's health and hastened his death. Yosef Levanon

Herzog, Émile. See **Maurois, André.**

Hesburgh, *HEHS burg,* **Theodore Martin** (1917-), a Roman Catholic priest, served as president of the University of Notre Dame from 1952 until he retired in 1987. Hesburgh also gave much time to government and foundation service. He was a member of the United States Commission on Civil Rights from 1958 to 1972 and served as chairman of the group from 1969 to 1972.

During the 1960's, Hesburgh greatly reduced his own powers and gave more authority to the Notre Dame faculty. He also started the practice of appointing laypersons to the university's board of trustees.

Hesburgh was born in Syracuse, New York. He be-

came a priest in 1943 and belongs to the Holy Cross order. He earned degrees at Gregorian University and Catholic University of America. He wrote *Patterns for Educational Growth* (1958) and *The Humane Imperative: A Challenge for the Year 2000* (1974). Gerald L. Gutek

Heseltine, *HEHZ uhl tyn,* **Michael Ray Dibdin** (1933-), was deputy prime minister of the United Kingdom from 1995 to 1997. A member of the Conservative Party, he served under Prime Minister John Major.

Heseltine was born in Swansea, Wales. He was educated at Oxford University. He worked as a real-estate developer and publisher before entering politics. He was elected to the House of Commons in 1966. From 1970 to 1974, he held posts in the Ministry of Transport, Department of the Environment, and Department of Trade and Industry.

Dowen/Gaywood, Gamma Liaison
Michael Heseltine

Under Prime Minister Margaret Thatcher, Heseltine served as secretary of state for the environment from 1979 to 1983 and for defense from 1983 until 1986. Heseltine challenged Thatcher for party leadership in 1990. When it was clear Thatcher would not win, she resigned. John Major was elected party leader and became prime minister. Major appointed Heseltine secretary of state for the environment in 1990. Heseltine held that post until 1992. He was secretary of state for trade and industry from 1992 to 1995, when Major appointed him deputy prime minister. Keith Robbins

Hesiod, *HEE see uhd* or *HEHS ee uhd,* was a Greek epic poet who probably lived during the 700's B.C. Scholars attribute two major poems, the *Theogony* and the *Works and Days,* to Hesiod. The *Theogony* combines traditional tales and Hesiod's ideas about the creation of the world, the succession of divine rulers, and the genealogy of the Greek gods. It is one of the earliest sources of information about Greek religion. See Mythology (Comparing myths; Greek mythology).

In the *Works and Days,* Hesiod examined human life and set forth his moral values. He addressed the poem to his brother, Perses. The *Works and Days* explains that life is difficult and people must work hard in spite of the just rule of Zeus, the king of the gods. The poem then tells the story of Pandora (see **Pandora**). The *Works and Days* also contains agricultural and moral advice to help people maintain a harmonious relationship with the gods. According to tradition, Hesiod was a farmer in Boeotia, a district of ancient Greece. Joseph R. Tebben

Hesperides, *hehs PEHR uh deez,* in Greek mythology, were the daughters of Hesperis (Evening) and Atlas, a member of a race of gods called *Titans.* The Hesperides were nymphs who lived at the western end of the world. There they guarded the golden apples that Gaea (Earth) had given to the goddess Hera when Hera married Zeus, king of the gods. A sleepless dragon helped the Hesperides guard the apples. As one of his 12 labors, the hero Hercules had to steal these apples (see Hercules). William F. Hansen

Hesperornis, *HEHS puh RAWR nihs,* is the name given to numerous species of diving birds that lived primarily in North America about 70 million to 90 million years ago, during the late Cretaceous Period. These birds looked somewhat like grebes or loons but had undeveloped wings and could not fly. They had teeth on their jaw and propelled themselves through water with their feet. They fed on fish. The largest species, *Hesperornis regalis,* measured about 5 feet (1.5 meters) long. *Hesperornis* fossils have been found in the western half of the United States—especially Kansas—and in western Canada and Alaska. See also **Bird** (The first known birds). Alan Feduccia

Hess, Myra (1890-1965), was an English pianist. She won fame for her performances of the works of Johann Sebastian Bach, Johannes Brahms, Wolfgang Amadeus Mozart, Domenico Scarlatti, and Ludwig van Beethoven. Hess also transcribed many Baroque music compositions for piano. In 1939, when all of London's concert halls were closed because of World War II (1939-1945), Hess established a series of weekday lunchtime concerts at the city's National Gallery. She and other artists performed in the concerts. In 1941, King George VI named Hess Dame Commander in the Order of the British Empire as a reward for organizing the concert series. She became known as Dame Myra Hess.

Hess was born in London. At the age of 12, she won a scholarship to the Royal Academy of Music. She made her debut in 1907 in London. Hess performed widely in Europe and North America. She made her United States debut in 1922 in New York City. Lydia Hailparn Ledeen

Hess, Rudolf (1894-1987), was deputy leader of the Nazi Party in Germany during the 1930's. In addition, he was German dictator Adolf Hitler's private secretary and one of his most loyal followers. In May 1941, during World War II, Hess piloted a plane to Scotland to persuade Britain to get out of the war and leave Europe to the Germans. Hess said that Hitler had no knowledge of Hess's plan. Hess was imprisoned in Britain until after the war ended in 1945. Later, at Nuremberg, Germany, Hess was tried and sentenced to life imprisonment for war crimes. He died in Spandau Prison in Berlin at the age of 93. Prison officials reported that Hess had hanged himself in his cell.

The Bettmann Archive
Rudolf Hess

Hess was born in Alexandria, Egypt. He served in the German Army in World War I (1914-1918). He became a Nazi in 1920, while a student at the University of Munich. He joined the Nazi Party after hearing its leader, Adolf Hitler, speak. Hitler was imprisoned in 1923 after a failed attempt to overthrow the German government. Hess began serving as Hitler's secretary while the imprisoned Hitler was writing *Mein Kampf* (1925), a book about his life and political ideas. In 1933, after Hitler became head of Germany, he appointed Hess deputy leader of the Nazi Party. Donald M. McKale

Hesse, *HEHS uh,* **Hermann** (1877-1962), a German novelist and poet, won the 1946 Nobel Prize for literature. Hesse's view of life was influenced by the German romantic writers and the Hindu philosophy of India. His novels concern the spiritual loneliness of people in a mechanized urban society, the conflict between intellect and sensuality, and the problems of people outside society, such as artists and vagabonds. The stories express a yearning for a synthesis between human sensual and intellectual capacities.

Hesse's best-known fiction includes *Knulp* (1915), *Demian* (1919), *Siddhartha* (1922), *Steppenwolf* (1927), *Narcissus and Goldmund* (1930, also called *Death and the Lover*), and *Magister Ludi* (1943, also called *The Glass Bead Game*). Hesse's simple, melodious poetry shows his love of nature. Like some of his novels, his poems tend to be self-conscious and sentimental.

Hesse was born in Calw in the Black Forest. He settled in Switzerland in 1919 and became a Swiss citizen in 1923. Werner Hoffmeister

Hessian fly, *HEHSH uhn,* is a tiny, two-winged insect. It is called *Hessian fly* because people once believed that it was brought to America in the straw bedding of Hessian troops during the Revolutionary War (1775-1783). It probably came from southern Russia. It is now found in wheat-growing areas of the United States and southern Canada, and in Africa and parts of Europe and New Zealand. The *larva* (maggot) attacks wheat crops. In some years, it has destroyed 10 percent of the U.S. and Canadian wheat crop. For methods of control, see Wheat (Controlling insect pests).

The adult Hessian fly is about $\frac{1}{8}$ inch (3.2 millimeters) long, with a dark brown body and dusky gray wings. Two generations of adults are produced each year—one in the spring and one in the fall. The female lays from 250 to 300 tiny, pale-red eggs. She deposits them on a wheat leaf or stalk. In about five days, whitish maggots hatch and crawl down between the leaf sheath and the stem. They suck juice from the stem.

Scientific classification. The Hessian fly is in the family Cecidomyiidae. It is *Mayetiola destructor.* E. W. Cupp

Hessians, *HEH shuhnz,* were German soldiers hired by the British to fight the colonists during the Revolutionary War in America (1775-1783). About 30,000 Hessians fought in the war. They were called *Hessians* because most of them came from Hesse-Kassel in central Germany. The Hessians were victims of a European system by which governments sold men into military service. They were paid about 25 cents a day. Princes who sold the Hessians' services pocketed a large bonus from the British government.

The Hessians were not particularly interested in the war, but they were well trained and fought well. Their performance in the battles of Long Island, Fort Washington, Brandywine, Newport, and Charleston caused the American troops to respect their fighting ability. The defeat of the Hessians at Trenton on Dec. 26, 1776, boosted American morale. Some Hessians were won over to the American cause and deserted the British army. Many remained in the United States after the war.

Donna J. Spindel

Hestia, *HEHS tee uh,* was the Greek goddess of the hearth. Hestia is the Greek word for hearth or fireplace. Because fire was essential to existence, the hearth became a symbol of life and was worshiped daily throughout the Greek world. However, the Greeks treated the hearth more as an object than a goddess with human qualities, and thus Hestia acquired no real mythology. The Greek poet Hesiod made Hestia the eldest daughter of the god Cronus and Cronus's sister Rhea. The unknown Greek author of the *Homeric Hymn to Aphrodite* listed Hestia among the few divinities who were not

Detail from *Capture of the Hessians at Trenton* (about 1790), an oil painting by John Trumbull; Yale University Art Gallery

The surrender of the Hessians after the Battle of Trenton on Dec. 26, 1776, raised the spirits of the American troops during the Revolutionary War. About 1,000 Hessians were captured.

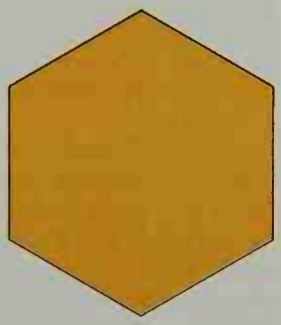
subject to desire. Vesta, the Roman goddess of the hearth, resembles Hestia (see **Vesta**). F. Carter Philips

Heteronym, *HEHT uhr uh nihm,* is a word having the same spelling as another word or words but different pronunciation and meaning. For example, the word *tear,* when pronounced *tair,* means to pull apart. But when it is pronounced *tihr,* it means a drop of salty liquid that comes out of the eye. See also **Homonym.** Sara Garnes

Heterotropia. See Strabismus.

Hewes, Joseph (1730-1779), was a North Carolina signer of the Declaration of Independence. He served in the Continental Congress from 1774 to 1777, and in 1779. While in Congress, he became the first executive head of the Continental Navy, though he did not have this official title at that time. He appointed John Paul Jones a Navy officer and provided him with a ship. Hewes was born on Jan. 23, 1730, in Kingston, New Jersey. He died on Nov. 10, 1779. Gary D. Hermalyn

Hexagon, *HEHK suh gahn,* is a plane figure that has six sides. It is a type of polygon. The sides of a hexagon meet at points called *vertices,* forming six interior angles. The sum of a hexagon's interior angles is always 720°. A hexagon is said to be *regular* if all its sides and angles are equal. Each angle of a regular hexagon measures 120°. The area of a regular hexagon equals one-half the product of its perimeter and its *apothem,* the distance from the center of a regular polygon to the midpoint of one of its sides. Arthur F. Coxford, Jr.



WORLD BOOK illustration

A regular hexagon has six sides of equal length.

Heydrich, *HY drihk,* **Reinhard,** *RYN hahrt* (1904-1942), was one of the most feared men in Nazi Germany. As chief of the security police, he treated "enemies of the state" with merciless brutality. Heydrich was the chief organizer of the *final solution,* a Nazi plan to murder all European Jews. He was killed by a bomb in Czechoslovakia on June 4, 1942. In revenge, the Nazis destroyed the village of Lidice and executed all its male inhabitants, condemned a thousand Czechs to death, and killed several thousand Jews. Heydrich was born in March 1904 in Halle, Germany. See also **Lidice.**

Donald M. McKale

Heyer, Georgette (1902-1974), was a British novelist who gained fame for her mystery stories and her historical fiction. Heyer wrote 56 novels.

Heyer wrote 12 mystery novels, starting with *Footsteps in the Dark* (1932). Like many other English mystery writers of the 1930's, she used a background of upper-class British life. Several of her mysteries feature Superintendent Hannasyde and Inspector Hemingway, both Scotland Yard detectives.

As a historical novelist, Heyer specialized in the Regency, the period from 1811 to 1820 in British history, when the Prince of Wales, later King George IV, served as *regent* (temporary ruler). Her first Regency novel was *Regency Buck* (1935). She became a respected Regency authority, and her novels have been praised for their authentic detail. Heyer was born in London on Aug. 16, 1902, and died on July 4, 1974. Jon L. Breen

Heyerdahl, *HY ehr dahl,* **Thor,** *thawr* (1914-2002), was a Norwegian ethnologist and author. In 1947, he sailed a balsa-wood raft named *Kon-Tiki* from Peru to the Tuamotu Islands in eastern Polynesia. He and five companions made the trip to test his theory that the islands of Polynesia could have been settled by Indians from South America. His book, *Kon-Tiki* (1950), tells the story of the voyage. In 1958, he wrote *Aku-Aku,* a book about Easter Island. In 1970, Heyerdahl and a crew of seven sailed a totora reed boat named *Ra II* from Morocco to Barbados in the West Indies. He claimed that this voyage proved that the ancient Egyptians could have sailed similar boats to the New World. Heyerdahl was born in Larvik, Norway, on Oct. 6, 1914. He died on April 18, 2002. Ben Finney

Wide World

Thor Heyerdahl

AP/Wide World

The *Kon-Tiki* was a wooden raft that carried Thor Heyerdahl and a crew across much of the Pacific Ocean in 1947. The voyage covered about 4,300 miles (6,920 kilometers).

Heyward, *HAY wuhrd,* **DuBose,** *duh BOHZ* (1885-1940), an American author, wrote poems and novels about the area around Charleston, South Carolina, his birthplace. He wrote mainly about the blacks of Charleston and the South Carolina sea islands. His most famous novel is *Porgy* (1925). Heyward and his wife, Dorothy, adapted it for the stage in 1927. George Gershwin used the story as the basis for his opera *Porgy and Bess* (1935). Heyward and Ira Gershwin collaborated on the opera's libretto and lyrics. Heyward's other novels include *Mamba's Daughters* (1929), which he adapted into a play with his wife in 1939; *Peter Ashley* (1932); *Lost Morning* (1936); and *Star-Spangled Virgin* (1939). Heyward wrote the books of verse *Skylines and Horizons* (1924) and *Jasbo Brown and Selected Poems* (1931). He was born on Aug. 31, 1885, and died on June 16, 1940. Bert Hitchcock

Heyward, Thomas, Jr. (1746-1809), an American patriot, statesman, soldier, and judge, was a

South Carolina signer of the Declaration of Independence. He served as a delegate to the Continental Congress from 1776 to 1778. Heyward was born on his father's plantation in what is now Saint Luke's Parish, South Carolina. He studied law in England. Heyward served in the provincial congresses of South Carolina in 1774 and 1775. He fought with the South Carolina state militia. James H. Hutson

Heywood, *HAY wud,* **Thomas** (1574?-1641), was a popular and productive English playwright of the Elizabethan Age. He claimed he wrote all or part of 220 plays, of which about 20 survive. Heywood's most enduring drama is *A Woman Killed with Kindness* (1603). This tragedy is almost unique in Elizabethan drama because the characters in the play are not of high rank, and the central situation is wholly domestic and free from political overtones. The play thus anticipates the direction that serious drama took almost 300 years later in the works of Henrik Ibsen.

Heywood's other plays include *Edward IV* (1599), *The Fair Maid of the West* (1610?), and adaptations of classical myths. Heywood also produced translations and pamphlets. His most important pamphlet was *An Apology for Actors* (1612). The pamphlet was a reply to Puritan attacks on the theater. Heywood was born in Lincolnshire. Albert Wertheim

Hezekiah, *HEHZ uh KY uh,* was the king of Judah from about 727 to 698 B.C. His name means "God strengthens" in Hebrew. During Hezekiah's reign, Judah was caught between the two major powers of Assyria and Egypt. Encouraged by the prophet Isaiah, Hezekiah resisted the mighty Assyrian army led by Sennacherib (see **Isaiah, Book of**). As a result, the Assyrians besieged Jerusalem in 701 B.C., but a plague struck them and forced them to withdraw. This story is told in the Bible in II Kings 18-19 and Isaiah 36-37.

Hezekiah is said to have "trusted in the Lord the God of Israel; so that there was none like him among all the kings of Judah . . ." (II Kings 18:5). This passage praised Hezekiah's attempts to reform religion in Jerusalem, and to rid Judah of idolatry. In the New Testament, Hezekiah is listed in the genealogy of Jesus Christ (Matt. 1:9-10).

Carole R. Fontaine

Hi-fi. See **Stereophonic sound system.**

HI-Y club is the general name for special teen-age and youth clubs sponsored by the Young Men's Christian Association (YMCA). The clubs try to help young people develop their highest mental, physical, social, and spiritual potentials.

Boys of high school age may join HI-Y clubs and girls of high school age may join TRI-HI-Y. Many YMCA's sponsor CO-ED HI-Y clubs for teen-agers. Other clubs include Jr. HI-Y, for junior high boys; Jr. TRI-HI-Y, for junior high girls; Gra-Y, for grade school boys; and Gra-TRI-Y, for grade school girls.

The HI-Y movement began in 1889. The various clubs seek to promote community service, personal growth, and the development of leadership skills. Each club determines its own activities and goals under the guidance of an adult adviser. HI-Y activities include recreational programs, service projects, and study and action programs on social problems and issues. The YMCA of the USA has national offices in Chicago.

Critically reviewed by the YMCA of the USA

Hiawatha, *hy uh WAH thuh* or *hee uh WAH thuh,* was an Iroquois Indian leader in precolonial America. He probably lived during the 1500's. He helped establish peace among the five major Iroquois tribes: the Mohawk, Oneida, Onondaga, Seneca, and Cayuga. The five tribes lived in what is now upper New York state and formed an alliance called the Great Peace or Iroquois League.

According to legend, Hiawatha fell into great grief and became a cannibal after his five daughters were killed through witchcraft. He was cured by a prophet named Deganawida, who was on a mission to unite the Iroquois. With Hiawatha as the spokesman, the two men went from tribe to tribe, persuading them to make peace.

The American poet Henry Wadsworth Longfellow made Hiawatha famous in his poem *The Song of Hiawatha* (1855). But he confused Hiawatha with the Chippewa, or Ojibwa, culture hero Nanabozho. Robert E. Powless

Hibbing (pop. 17,071) is a city in northeastern Minnesota. It is often called the *Iron Ore Capital of the World.* Hibbing is the chief community on the rich Mesabi iron range. For the location of the city, see **Minnesota** (political map).

Hibbing was founded in 1893. In 1919, it was moved about 2 miles (3 kilometers) south of its original location because of the expansion of the Hull-Rust open-pit mine. This huge mine, covering about 2,300 acres (930 hectares), produces millions of tons of *taconite* ore each year. Taconite is a rock that contains iron. When the steel industry of the United States declined in the 1980's, the city's economy suffered and its population declined nearly 15 percent. Hibbing hosts the annual St. Louis County Fair. The Greyhound Bus Lines originated in Hibbing in 1914. Clifford E. Clark, Jr.

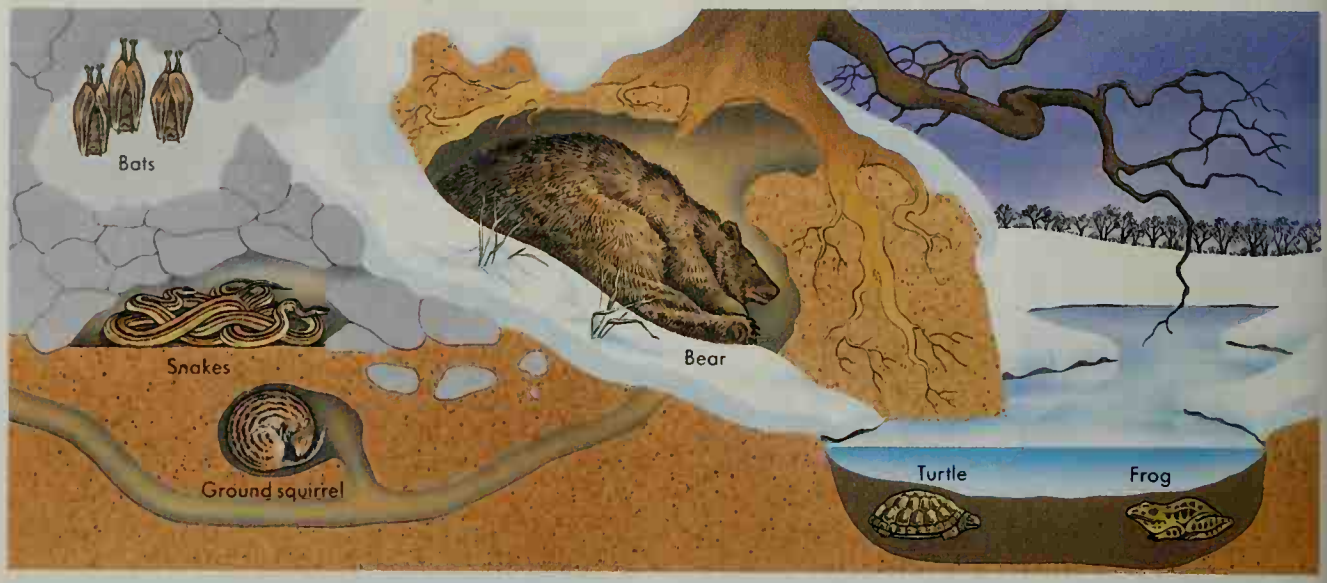
Hibernation is an inactive, sleeplike state that some animals enter during the winter. Animals that hibernate protect themselves against the cold and reduce their need for food. A hibernating animal's body temperature is lower than normal, and its heartbeat and breathing slow down greatly. An animal in this state needs little energy to stay alive and can live off fat stored in its body. Thus, hibernating animals can more easily survive cold winters when food is scarce.

Warm-blooded hibernators include such birds as nighthawks and swifts; and such mammals as bats, chipmunks, ground squirrels, hamsters, hedgehogs, fat-tailed lemurs, and marmots. Most of these animals eat large amounts of food in the fall. The food is stored in the animals' bodies as fat, which provides energy during hibernation. Hibernating birds and mammals do not sleep straight through the winter. Instead, these animals experience several *bouts*—periods of deep hibernation—that alternate with periods of wakefulness. They are able to arouse themselves from hibernation at any time and may also be aroused by heat. A few hibernators store food in their caves or burrows. They eat this food between bouts.

Some bears experience a period of *dormancy* (inactivity) in the winter that is characterized by a prolonged sleep. Scientists disagree on whether or not this winter sleep is true hibernation. Many scientists do not classify bears as hibernators because a bear's body temperature falls only slightly during dormancy. The scientists also point out that bears are easily aroused from their winter

Animals that sleep through the winter

WORLD BOOK illustration by Sarah Woodward



sleep. Many other scientists, however, believe that bears are true hibernators. They argue that a bear's heart rate drops to less than half of normal during winter sleep. These scientists think that bears have a high body temperature when dormant because their large bodies do not lose as much heat as do the small bodies of other hibernators.

Cold-blooded hibernators include such amphibians as frogs and toads; and such reptiles as lizards, snakes, and turtles. The body temperature of these animals rises and falls with the temperature of the environment. When cold weather causes their body temperature to drop, the animals enter hibernation. An amphibian or reptile can only be aroused from hibernation when its environment warms up enough to heat its body.

Other kinds of dormancy. Some species of bats are dormant each day and active each night. Some birds, such as hummingbirds, are active during the day and dormant at night. These types of dormancy are known as *diurnal torpidity.* Some animals become dormant in the summer to protect themselves from heat and drought. This type of dormancy is called *estivation.* Many insects experience *diapause,* a period of inactivity and lack of growth. Diapause can occur in any season. When it occurs during the winter, it is sometimes called hibernation. Barbara A. Horwitz

Related articles in *World Book* include:
Bat (Hibernation and migration)
Bear (Winter sleep)
Butterfly (Hibernation)
Estivation
Insect (Hibernation and migration)
Snake (Regulation of body temperature)
Turtle (Hibernation)

Hibernia is an old name for Ireland. It comes from the Latin *Juverna,* which scholars believe to be the name Julius Caesar gave the country. Many uses of the name can be found in the Greek and Latin classics, especially in the writings of the Greek geographer Ptolemy, who described Ireland in detail. Arthur M. Eckstein

Hibiscus, *huh BIHS kuhs* or *hy BIHS kuhs,* is the name of a group of plants that belong to the mallow family. The *swamp rose mallow* grows wild in marshes in the Eastern United States, sometimes growing 7 feet (2 meters) high. It has white or pink flowers 4 to 7 inches (10 to 18 centimeters) across. The *rose of Sharon,* also called *althaea,* is native to Asia. But United States gardeners often cultivate it as a small tree or shrub for borders and background. Its flowers resemble those of the hollyhock.

The tropical *Chinese hibiscus* has striking blossoms that the Chinese sometimes use to stain their eyebrows and teeth. Both the rose of Sharon and the Chinese hibiscus can have single or double flowers that vary in color from white, pink, and red to lavender. *Okra* is a summer annual hibiscus of the vegetable garden. Its sticky pods are used in soups and stews. Other kinds of hibiscus are grown for their fiber.

Scientific classification. Hibiscus belong to the mallow family, Malvaceae. They make up the genus *Hibiscus.* The swamp rose mallow is *Hibiscus moscheutos.* The rose of Sharon

WORLD BOOK illustration by Christabel King

The Chinese hibiscus, *above,* makes a colorful garden flower. Hibiscus plants also have other uses. For example, people cook the pods of *okra,* another kind of hibiscus, as vegetables.

is *H. syriacus* and the Chinese hibiscus, *H. rosasinensis.* Okra is *H. esculentus.* Michael A. Dirr

See also Flower (picture: The structure of a hibiscus); Okra.

Hiccup, also called *hiccough,* is an abrupt, involuntary intake of air caused by a spasm of the diaphragm. The *diaphragm* is a large, powerful, dome-shaped muscle that lies at the base of the chest cavity. It contracts and relaxes like a bellows to aid breathing. Normally, these contractions are rhythmic and gentle. But irritation of organs near the diaphragm, or, sometimes, certain diseases, may cause the diaphragm to contract suddenly. This spasm pulls air into the lungs through the *larynx* (voice box). The larynx is flanked by the vocal cords and topped by the *epiglottis,* a movable cap that keeps food from getting into the air passages. The epiglottis closes over the larynx when the diaphragm suddenly contracts. When the spasm of the diaphragm pulls air into the larynx, the air forcibly strikes the closed epiglottis and causes a movement of the vocal cords. These actions result in the *hic* sound that we hear.

The *hiccup* (spasm) may occur several times in a minute. Hiccups may last for several hours, or, rarely, for several days. People can sometimes stop ordinary hiccups by breathing deeply, by holding their breath, or by breathing into a paper bag. Charles W. Cummings

See also Diaphragm; Larynx.

Hickam Air Force Base, Hawaii, is the headquarters of the Pacific Air Forces, which includes United States Air Force units in Japan and Korea. The base covers about 2,800 acres (1,100 hectares) west of Honolulu. A Japanese air attack on nearby Pearl Harbor on Dec. 7, 1941, killed 121 airmen and destroyed 64 aircraft on the base. Hickam Air Force Base was established in 1935 and named for Lieutenant Colonel Horace M. Hickam, who died in an aircraft accident in 1934.

Wayne Thompson

Hickey, James Aloysius Cardinal (1920-), was appointed a cardinal of the Roman Catholic Church by Pope John Paul II in 1988. The pope had appointed him archbishop of Washington, D.C., in 1980.

Hickey was born on Oct. 11, 1920, in Midland, Michigan. He was ordained a priest in 1946. He served as secretary to the bishop of Saginaw, Michigan, from 1951 to 1960. Hickey was rector of St. Paul Seminary in Saginaw from 1960 to 1968 and auxiliary bishop of Saginaw from 1967 to 1969. He was rector of North American College in Rome from 1969 to 1974, when he became bishop of Cleveland. Hickey held this position until his appointment as archbishop of Washington, D.C. Cardinal Hickey retired as archbishop of Washington, D.C., in 2001.

Kenneth Guentert

Hickok, Wild Bill (1837-1876), was an American frontier Army scout, peace officer, stagecoach driver, and gambler. He is best remembered for his brief and violent service as a sheriff and marshal in Kansas. Hickok's adventures and questionable killings made him a legend even during his own lifetime.

James Butler Hickok was born on May 27, 1837, in Troy Grove, Illinois. As a youth, he gained a reputation as an expert marksman and a tough, greatly feared fighter. Hickok left home in 1855 and got jobs as a farmworker, police officer, stagecoach driver, and wagon master.

During the American Civil War (1861-1865), Hickok served the Union as a spy and scout. According to legend, he was given the nickname "Wild Bill" during this period. Hickok became a deputy United States marshal in 1866. In 1867, he scouted for the Army's Seventh Cavalry Regiment, commanded by the famous Indian fighter Lieutenant Colonel George A. Custer.

Kansas State Historical Society

Wild Bill Hickok, an American frontier scout and peace officer in the West, served as a sheriff and marshal in Kansas.

In 1869, Hickok won election to the office of sheriff of Ellis County, Kansas. He spent most of his time in Hays City, Kansas, which was a wild frontier town. As sheriff of Ellis County, Hickok killed two men. He lost a reelection bid in November of that year. In 1871, Hickok served as marshal of Abilene, Kansas. There, Hickok shot and killed a gambler and, by mistake, a policeman. He drew much criticism for his violent responses to rowdy drunks.

During the next few years, Hickok drifted through the West gambling and performing in a play called *Scouts of the Prairie.* In 1876, he moved to Deadwood in the Dakota Territory during a gold rush. Hickok hoped to strike it rich but was unsuccessful. He was shot and killed by a town worker named Jack McCall while playing cards in the No. 10 Saloon. Hickok fell to the floor, still clutching a pair of aces and eights, known ever since as the "dead man's hand." Roger D. McGrath

Additional resources

Green, Carl R., and Sanford, W. R. *Wild Bill Hickok.* Enslow, 1992. Younger readers.

Rosa, Joseph G. *The West of Wild Bill Hickok.* 1982. Reprint. Univ. of Okla. Pr., 1994. *Wild Bill Hickok: The Man and His Myth.* Univ. Pr. of Kans., 1996.

Hickory is the name of a group of medium-sized to large broadleaf trees. There are about 15 species of

hickories, most of which are native to North America. Four species are native to eastern Asia. Hickories are valuable for their tough, hard wood. Some species are known for their edible nuts.

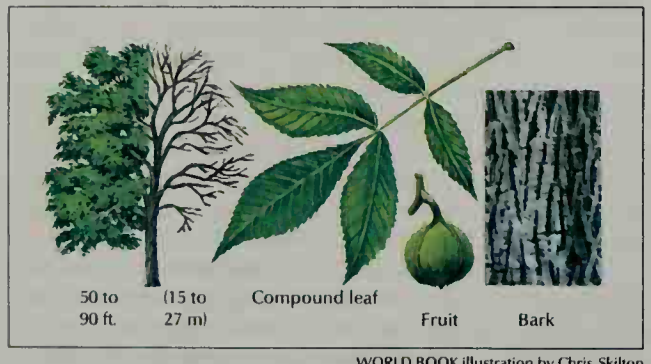
Hickories are common in the broadleaf forests of the eastern and central parts of the United States. Some species may grow 100 to 150 feet (30 to 45 meters) high. Some live 200 to 500 years.

Hickories have straight trunks and spreading branches. The leaves are made up of 3 to 17 toothed leaflets. In the spring, hickories bear clusters of small greenish flowers. The flowers are pollinated by the wind. The fruit consists of a round to oblong, hard-shelled nut inside a tight husk. During ripening, the husk typically splits into four sections. The nuts fall in September and October and are eaten by many mammals and birds.

Manufacturers use hickory wood for the handles of tools, especially axes, hammers, and picks. In addition, the wood is used for baseball bats and furniture. At one time, wagon makers fashioned wheels out of hickory wood.

Hickory wood is very heavy and dense. As a result, it burns slowly and produces much heat. It is often used for smoking and curing meats. Bacon and ham have a fine flavor when cured in hickory smoke.

The *pecan* is a species of hickory cultivated for its sweet, high-quality, thin-shelled nuts. It is native to the Mississippi River Valley, but it is widely planted elsewhere. The *bitternut hickory* is the most widespread hickory in eastern North America. Its nuts are too bitter-tasting for people to eat. The *shagbark hickory* has shaggy bark that peels off in long, curved strips. Its sweet, edible nuts once served as a basic food for many American Indian tribes. Shagbark hickory wood is used to make high-quality charcoal. The *mockernut hickory* is the most common hickory species in the southern part of the United States. It provides one of the best woods for manufacturing purposes. The *pignut hickory* usually yields the heaviest commercial hickory wood.



WORLD BOOK illustration by Chris Skilton

The pignut hickory is one of the most common hickory trees in central and eastern North America. Its tough, hard wood is used to make handles for hammers, axes, picks, and other tools.

Michael J. Baranski

Scientific classification. Hickories belong to the walnut family, Juglandaceae. The scientific name for the pecan is *Carya illinoensis;* the bitternut hickory, *C. cordiformis;* the shagbark, *C. ovata;* the mockernut, *C. tomentosa;* and the pignut, *C. glabra.*

See also **Bitternut hickory; Pecan; Tree** (Familiar broadleaf and needleleaf trees [picture]); **Walnut; Wood** (picture: Some types of wood).

Hicks, Edward (1780-1849), was an untrained American folk painter whose works reflect his Quaker religious beliefs. At the age of about 22, Hicks became an unpaid, wandering Quaker minister. This was his main vocation. Hicks had developed an extraordinary sense of design while he was apprenticed to a carriage maker. Throughout his life, Hicks supported himself by decorating carriages and tavern signs. The bold, flat colors and strong outlines he developed during these activities are the main characteristics that dominate Hick's paintings.

From 1820 to 1849, Hicks painted more than 60 versions of *The Peaceable Kingdom,* which he based on the Biblical prophecy in Isaiah 11: 6-9. In God's peaceable kingdom, the lion would lie down with the lamb and a child would lead all creatures. Quakers believed that salvation lay in the "peaceable kingdom" of a serene and well-ordered heart. Hicks visualized this belief in spiritual landscapes crowded with animals that symbolize human vices and virtues. In addition, Hicks painted patriotic historical themes and rural scenes. He was born on April 4, 1780, in Attleborough (now Langhorne), Pennsylvania.

Deborah Leveton

See also **Folk art** (picture: A folk painting).

Hidalgo y Costilla, Miguel, *ee DAHL goh ee kohs TEE yah, mee GEHL* (1753-1811), a Mexican priest, is called "The Father of Mexican Independence." He led his followers in a revolt against their Spanish rulers.

On Sept. 15, 1810, Hidalgo rang the bells of his church in the little village of Dolores. When the church members had gathered, Hidalgo shouted the famous *Grito de Dolores* (cry of Dolores), in which he called for independence.

Hidalgo encouraged his people to drive out the foreign rulers and led his untrained soldiers against Spanish troops. For a short time, Hidalgo's forces were successful, but they could not stand up against the well-trained and well-equipped Spaniards. In 1811, the Spaniards captured Hidalgo and put him to death. Mexico won independence from Spain in 1821.

Mexico now celebrates September 16 as Independence Day. Each year on September 15, the president of Mexico rings a bell in Mexico City and repeats the *Grito de Dolores.* Most towns have a Hidalgo monument or a Sixteenth of September street.

Hidalgo was born on May 8, 1753, in the state of Guanajuato and was educated in Valladolid (now Morelia) and Mexico City. In 1803, he went to the parish of Dolores. There, he introduced silk manufacturing, brickmaking, vineyards, and other industries to help the Mexican *peons* (laborers).

W. Dirk Raat

See also **Mexico** (Revolt against the Spaniards).

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Hidatsa Indians. See **Gros Ventre Indians.**

Hide. See **Leather.**

Hideyoshi, *hee deh yoh shee* (1536 or 1537-1598), was a Japanese military and political leader who reunited the country after civil war had divided it. Hideyoshi was born a peasant in what is now Aichi Prefecture. He joined the army of Oda Nobunaga, who sought to rule all of Japan, and became a successful general.

After Nobunaga was assassinated in 1582, Hideyoshi took over the task of uniting the nation. He formed alliances with powerful enemies and defeated weak enemies in battle. In 1586, Hideyoshi took the surname *Toyotomi,* which means *bountiful minister.* Toyotomi Hideyoshi ordered a land survey and revised the land tax. To prevent rebellions, he demolished many armed family forts and allowed only soldiers to own weapons.

He tried unsuccessfully to conquer Korea in 1592 and 1597. Hideyoshi's accomplishments aided the Tokugawa dynasty, which came to power after his death and ruled Japan for the next 265 years. Thomas G. Nelson

Hieroglyphics, *HY uhr uh GLIHF ihks,* is a form of writing in which picture symbols represent ideas and sounds. The word *hieroglyphics* comes from two Greek words that mean *sacred carving.* Hieroglyphics usually refers to the writing of ancient Egypt. However, forms of picture writing were used in other ancient cultures as well, notably by the Hittites, who lived in the region that is now Turkey, and by the Maya and Aztec Indians of Central America.

The ancient Egyptians used hieroglyphic writing for more than 3,000 years. They used hieroglyphic writing primarily for religious inscriptions on temples and stone monuments and to record the words and deeds of royalty. In fact, the Egyptians called their writing *the words of God.* The inscriptions were written or carved by highly trained men who were called *scribes.*

After the A.D. 300's, the Egyptians replaced their other forms of writing with a simpler alphabet that was borrowed mainly from Greek. Understanding of hieroglyphic symbols was soon lost and remained a mystery until the early 1800's, when scholars deciphered the writing.

Development of hieroglyphic writing. The ancient Egyptians borrowed the idea of hieroglyphic writing from Mesopotamia about 3000 B.C. Egyptian hieroglyphics generally included about 800 symbols. However, by about 300 B.C., there were more than 6,000 symbols. The symbols have the elegant, stiff quality typical of ancient Egyptian art.

The earliest *hieroglyphs* (symbols) contained many pictorial characters known as *pictographs* or *ideograms.* These characters were literal representations of ideas. For example, Egyptians who wished to express the idea of a woman drew a picture of a woman.

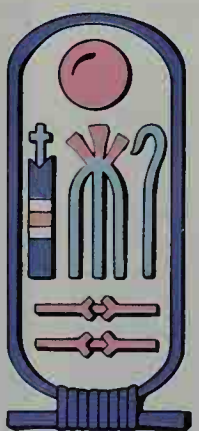
The earliest writings of the Egyptians also included *phonetic* hieroglyphs, also called *phonograms.* Such hieroglyphs, like the characters of modern alphabets, represented the sounds of the language. Some represented only one sound. Others represented combinations of two or three sounds that formed syllables. But the phonetic symbols represented only the sounds of consonants. The Egyptians did not write the vowels. Thus, scholars remain unsure of how the ancient Egyptian language was pronounced.

Egyptian hieroglyphs included *determinatives.* Determinatives indicated the class of object to which the preceding hieroglyphs belonged. An example of a determinative might be the symbol for water placed after the name of a specific lake. Such symbols helped explain and emphasize the meaning of other hieroglyphs.

Some hieroglyphic texts are read from right to left and others from left to right, depending on the direction the hieroglyphs face. Scribes also wrote in columns,

© Brian Brake, Photo Researchers

These symbols mean *Lord of Crowns.* The top symbol is a basket, which stands for *Lord.* Beneath the basket is a phonetic sign that probably represents *crown.* The three strokes to the left of the sign represent a plural.



This illustration is a *cartouche* of the pharaoh Ramses III. A cartouche is an oval frame that contains the name of a ruler. The translation of this cartouche is *Ramses, Ruler of Heliopolis.* The circle at the top represents the sun god Ra. Beneath the circle at the left is a pillar that stands for the city of Heliopolis. In the center is the symbol of three fox skins, which represents the letters *m s.* The shepherd's staff at the right stands for ruler. The two door bolts at the bottom represent forms of the letter *s.*

WORLD BOOK illustration by Bill and Judie Anderson

Egyptian hieroglyphics, *left,* were painted inside the tomb of the son of the pharaoh Ramses III during the 1100's B.C. The pharaoh is shown with the Egyptian goddess Isis. The illustration at the right interprets the hieroglyphics painted nearest the head of Ramses.

which were read from top to bottom. Hieroglyphs often served as decoration. Sometimes, the symbols were painted with brilliant colors or covered with gold.

As writing became more common, the need developed for a material that was easier than stone to write on, store, and transport. For this purpose, the Egyptians invented *papyrus,* a paperlike material made from a reed plant. Scribes wrote on papyrus with brushes made of reeds. The tips of the reeds were softened and shaped into a point. Soot mixed with water served as ink.

The Egyptians used this simplified *cursive* (connected) script called *hieratic* writing for writing quickly on papyrus. Hieratic writing resembled hieroglyphic writing in much the same way that modern longhand resembles printing. Scribes used hieratic script for both religious and nonreligious purposes.

Later, about 700 B.C., a script called *demotic* became popular. It was simpler and could be written faster than hieratic writing. Scribes also used the script for correspondence and record-keeping. Demotic writing was widely used for about 1,000 years.

Deciphering hieroglyphic writing. The Egyptians eventually stopped using their own writing systems, replacing them with an essentially Greek alphabet. The phonetic values and other uses of the hieroglyphs were forgotten. People came to believe that the hieroglyphs really represented a secret and magical code used by Egyptian priests.

In 1799, a French officer in the army of Napoleon I discovered a stone tablet near the mouth of the Nile River near Rosetta, Egypt. The tablet, named the Rosetta stone, carried an inscription in three scripts—Egyptian hieroglyphic, Egyptian demotic, and Greek. By reading the Greek portion of the stone, scholars learned that the text consisted of a decree, issued in 196 B.C., honoring King Ptolemy V.

Scholars attempted to translate the Egyptian script using methods that were similar to modern cryptography. In 1814, Thomas Young, a British physician and scholar, discovered that some hieroglyphics were phonetic signs. In addition, scholars learned that hieroglyphs enclosed in an oval ring, called a *cartouche,* represented names of individuals.

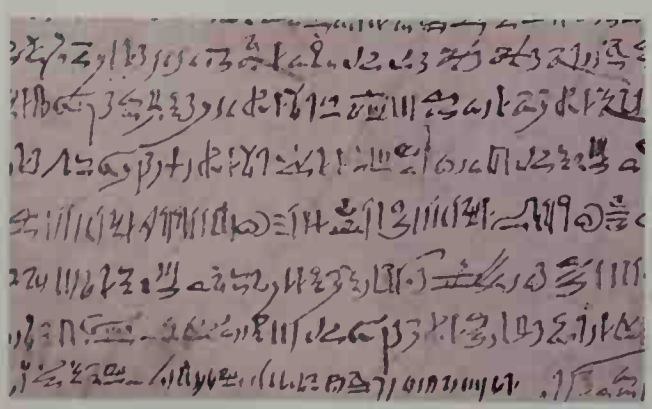
In 1822, a French scholar named Jean François Champollion achieved a breakthrough in deciphering the hieroglyphs of the Rosetta stone. By studying the position and repetition of proper names in the Greek script, he picked out the same names in the Egyptian scripts. In addition, Champollion's knowledge of Coptic, the last stage of the ancient Egyptian language written with mostly Greek letters, helped him recognize many ancient Egyptian words in the hieroglyphic part of the text. Eventually, he deciphered the entire text.

Today, grammars and dictionaries enable scholars to read Egyptian hieroglyphic writing easily. Knowledge of ancient Egyptian history would be nearly impossible to obtain without the ability to read hieroglyphics.

Other hieroglyphic writing. In Central America, the earliest examples of Maya hieroglyphs date from about A.D. 250. Maya hieroglyphs consisted of a combination of ideograms that represented entire ideas or words and phonetic hieroglyphs that represented syllables.

Peabody Museum, Harvard University

Maya hieroglyphics consisted of ideograms representing ideas or things and phonetic hieroglyphs representing syllables. The Maya carved hieroglyphs on stone.



Oriental Institute, University of Chicago

Hieratic writing is a simplified script form of Egyptian hieroglyphics. The text shown here, from the 1100's B.C., is part of a creditor's plea for justice concerning repayment of a loan.

© Ronald Sheridan

Hittite hieroglyphics represented words or phonetic syllables. The Hittites developed their writing system about 1500 B.C., while they were a leading power in the Middle East.

The Maya carved hieroglyphs on buildings and on large stone monuments called *stelae.* These carvings frequently recorded important historical events in the lives of Maya rulers. In addition, the Maya painted hieroglyphs on pottery and wrote on paper made from fig tree bark. The Maya are the only ancient American people known to have developed a writing system that could express all the words in their language.

Aztec hieroglyphs consisted of pictographs, which also had a phonetic value. The Aztec combined the symbols of several objects to form the sound or name of an object or abstract idea not represented by a pictograph. These symbols resemble *rebus* writing (see **Rebus**).

The Hittites developed hieroglyphic writing about 1500 B.C. Some Hittite symbols represented words. Others represented phonetic syllables. Leonard H. Lesko

Related articles in *World Book.* For examples of hieroglyphics, see:

Alphabet
Aztec (picture: Aztec writing)
Cartouche
Hittites
Maya (picture: Maya writing)
Numeration systems (The Egyptian numeral system)
Rosetta stone

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Higgins, Andrew Jackson (1886-1952), an American shipbuilder, designed and built landing craft to take troops and tanks ashore for amphibious assaults during World War II (1939-1945). His firm, the Higgins Aircraft Company and Higgins Engine Company, Inc., also made plywood cargo planes for the Army. After the war, the firm made prefabricated houses. He organized his business in 1930. Higgins was born on Aug. 28, 1886, in Columbus, Nebraska. He began building boats when he was 12 years old. Later, he worked as a lumberman and established his own lumber company. James C. Bradford

Higgs, Peter Ware (1929-), a British physicist, developed a theory to answer a fundamental question of physics: Why do electrons, protons, and other subatomic particles have *mass?* Mass is the quantity of matter in an object. According to Higgs's theory, space is filled with special particles that interact with electrons, protons, and other objects to give them mass.

Higgs developed the theory in 1964. At about the same time, the Belgian physicists Robert Brout and François Englert, working independently of Higgs, described the same interaction. The interaction came to be known as the *Higgs mechanism,* and the special particles are called *Higgs bosons.* Both are essential parts of the *Standard Model,* the leading theory of subatomic particles and their interactions.

Scientists have searched for the Higgs boson in experiments with machines known as *particle accelerators.* But by the early 2000's, they had found no clear evidence of the particle.

Higgs was born on May 29, 1929, in Newcastle upon Tyne, England. In 1954, he received a Ph.D. degree in physics from King's College, University of London. He was on the faculty of the University of Edinburgh in Scotland from 1960 until he retired in 1996. Peter Pesic

See also **Boson; Higgs boson; Particle accelerator; Subatomic particle.**

Higgs boson is a subatomic particle—yet undiscovered—thought to be the source of the mass of all other particles that have mass. Mass is the property of an object that accounts for its weight. The Higgs boson is named for British physicist Peter Higgs, who proposed a theory in 1964 suggesting that such a particle exists.

Higgs developed his theory to explain a surprising discovery about the forces that act between subatomic particles. Physicists had known that these forces have certain mathematical properties called *symmetries.* Well-accepted theories indicated that the symmetries apply only to particles that have no mass. But experiments showed that the symmetries also apply to particles with mass. Higgs said that what became known as the Higgs boson contributes mass to the other particles. Those particles retain the relationship to the symmetries characteristic of massless particles.

The Higgs boson, if it exists, has a large mass for a subatomic particle. Estimates range from about 400 to 1,000 times the mass of a proton. One of the most powerful of the research machines called *particle accelerators* may soon create observable numbers of Higgs bosons. Robert H. March

See also **Higgs, Peter Ware; Particle accelerator; Subatomic particle.**

High blood pressure. See **Hypertension.**

High Desert is located in central Oregon between the Blue Mountains and the Basin and Range Region (see **Oregon** [physical map]). It occupies the Malheur Basin, which ranges in elevation from 4,000 to 5,000 feet (1,200 to 1,500 meters). Volcanic ash blankets much of the area. Cinder cones are features of the western section. Localized interior drainage and temporary lakes are common. The High Desert area is very thinly populated. It is used for seasonal grazing. John Edwin Coffman

High-fidelity system. See **Stereophonic sound system.**

High jump is a track and field event in which an athlete tries to jump over a bar supported by two posts 13 feet 1 $\frac{1}{2}$ inches (4 meters) apart. The jumper lands in a pit of foam rubber, or on an air-inflated pad.

A jumper takes a running start and may approach the bar from any angle. Most jumpers use the *Fosbury flop,* while a few use the *straddle.* Jumpers using the Fosbury flop take off on the outside foot—that is, the foot farthest from the bar. They turn their back to the bar, arch their back over the center of the bar, and kick their legs out to clear it. They land on their shoulders and back.

In the straddle, jumpers take off on their inside foot—the foot nearer the bar. They approach at a slow run and, when ready to jump, plant their take-off foot about an arm's length from the bar. As they spring, their outside leg and both arms swing upward. The jumpers have their abdomen and face toward the bar when they kick their outside leg over. They roll over so their inside leg comes over last.

The straddle was by far the most popular high-jump style until the late 1960's, when the Fosbury flop became famous. This style was originated by Dick Fosbury, a student at Oregon State University. Using this new jumping style, Fosbury set an Olympic high-jump record of 7 feet 4 $\frac{1}{4}$ inches (2.24 meters) at the 1968 Summer Games.

In a track and field meet, the bar is placed at successively higher levels. Jumpers remain in the competition until they miss three consecutive times. They get credit

Tom Pantages

A high jumper can use one of several techniques to clear the bar. In the Fosbury flop, *shown here,* the jumper goes over the bar backward and lands on his shoulders and back in the pit.

for the highest height they clear. In most major meets, an athlete in men's competition must leap at least 7 feet 6 inches (2.29 meters) to finish among the top three. Women must leap about 6 feet 2 inches (1.88 meters).

Michael Takaha

For world championship figures in the high jump, see the tables with the articles **Track and field** and **Olympic Games**.

High-lift devices. See Aerodynamics.

High priest was the head of the Jewish priesthood in later Biblical times. He represented the Jewish people before God. His duties were to take care of the Temple and sanctuary and all its services. He was also the chief of the *Sanhedrin,* the highest governing council of the Jews. When he became high priest, he was anointed with holy oil as a symbol of authority.

There were special rules for a high priest's conduct (Leviticus 21). For example, he was permitted to marry only a virgin of Israel. His official costume included a blue robe, partly covered with an embroidered garment called an *ephod.* On his head he wore a linen turban called a *miter.* He had a golden breastplate set with 12 precious stones that bore the names of the 12 tribes of Israel. Only the high priest was permitted to enter the Holy of Holies (see Tabernacle). He then wore a white linen robe.

Aaron, the brother of Moses, is believed to have been the first high priest of Israel (see **Aaron**). At first, a high priest served for life. Later, Herod and the Romans appointed and dismissed high priests as they wished.

Carole R. Fontaine

High school is a school that provides several years of education for young people beyond the elementary level. High schools also are called *secondary schools.* In the United States, a majority of high schools begin with ninth grade and offer four-year programs. High schools provide a general education and prepare students either for colleges, universities, or technical schools, or for a vocation. Canadian high schools are similar to those in the United States.

The United States has one of the world's highest high school enrollment rates. Almost all U.S. girls and boys enter high school, and about 75 percent graduate. For the number of U.S. high schools, see **School** (High schools).

High schools in the United States offer *college preparatory programs* and *vocational programs.* College preparatory programs give students the necessary background for admission to a college or university. Vocational programs prepare students for jobs immediately following high school.

All high schools offer *required* courses—that is, classes in such subjects as English, science, and social studies. High school students also may choose from a wide variety of *elective* courses, such as music, foreign languages, or industrial arts. *Extracurricular* high school activities, which occur outside of classroom time, include sports, clubs, and plays.

Most United States high schools are free public schools supported chiefly by state and local taxes. Each local school district has a governing body, usually a school board, that makes school policies and monitors the quality of education that students receive. A superintendent administers the district policies. Each high school is headed by an experienced educator, usually called the principal.

About 90 percent of students in the United States attend public high schools. The United States also has several types of secondary schools outside the public-school system. Most of these *private schools* charge tuition. They include *parochial schools,* which are operated by the Roman Catholic Church or other religious groups, and private college preparatory schools, also called *prep schools.* Prep schools prepare students for admission to colleges and universities. Each state has laws and rules that its high schools must follow.

High schools in other countries. The secondary school systems of Canada and many European countries resemble the U.S. systems. But some of these countries offer college preparatory programs and vocational programs in separate schools. Most developed countries have well-established secondary school systems. For example, secondary school enrollment in Canada includes about 90 percent of all youths of high-school age. In Japan and some European nations, the secondary school enrollment rate is even higher. However, in some developing nations, only about 10 percent of this group are enrolled.

Development of U.S. high schools. Secondary education in North America began about 350 years ago, during colonial times. The first free, public high school in the United States opened in Boston in 1821. Not until the 1900's did high schools become institutions designed to educate all young people.

Chris Buethe

Related articles in *World Book.* See the *Education* section of various country articles. For example, see **Germany** (Education). See also **Education; Junior high school; Middle school; Parochial school; Private school; School.**

High seas are the areas of the oceans that lie outside the authority of any nation. They generally begin 200 nautical miles from the coasts of nations that border the oceans. A nautical mile is equal to about 1.2 statute miles and 1.9 kilometers. The high seas are also called *international waters.* Areas of the oceans over which nations exercise control include a nation's *territorial waters* (see **Territorial waters**).

All nations are expected to follow international rules regarding the high seas. Under international law, the high seas are open to every nation for fishing, travel, and research. All nations have equal rights on the high seas and must respect one another's rights.

During wartime, international law allows neutral nations to continue trading with other neutral nations and with nations at war. In such times, however, the ships of neutral nations are not supposed to carry *contraband of war* (illegal goods). The nations at war decide what materials they consider contraband of war.

Nations have long argued over the law of the sea. Between 1968 and 1982, the United Nations (UN) worked to establish a set of sea laws that would satisfy all nations. The UN's work led to the signing of the Law of the Sea Convention in 1982. This treaty was signed by more than 100 UN members. Under the treaty's terms, however, the agreement would go into effect only after 60 nations had ratified it. As a result, the agreement did not take effect until 1994. However, the United States and Canada did not ratify the treaty.

In general, the Law of the Sea Convention gives countries exclusive rights to drill for oil and gas up to 200 nautical miles (370 kilometers) from shore—and in certain cases even farther from shore—and to fish within the 200-nautical-mile limit. Within these 200 nautical miles, called the *exclusive economic zone,* the treaty gives all nations high seas rights of navigation and flight. However, it allows the coastal nations to control all the economic resources in this zone. Most nations agree that mining is not a part of the freedom of the sea and can proceed only under the treaty's terms.

William T. Burke

See also **Contraband; International law; Neutrality; Pirate; Right of search; Law of the Sea Convention.**

Highland Clearances were a series of evictions in the Scottish Highlands that took place from the late 1700's to the mid-1800's. Landowners expelled thousands of families from their homes to "clear" land for large sheep farms, which were more profitable than the families' small farms.

The first clearances began about 1780. Some landowners burned their tenants' cottages so they could not return. Many landowners relocated the Highlanders to small farms called *crofts* along the rocky coast of Scotland. There the farmers, called *crofters,* supplemented their crops by fishing or harvesting kelp, a type of seaweed used in soap and glass making. The fishing was not widely successful, and the price for kelp dropped because the demand for it declined. The tenants could not pay their rents, and many landlords eventually had to sell part or all of their land.

Beginning in 1820, and especially after a plant disease destroyed potato crops during the 1840's, landowners encouraged the evicted crofters to emigrate. Many Highlanders went to Australia, Canada, and the United States. The evictions began to decline during the late 1850's.

During the 1880's, the crofters withheld rent, fought with police, and carried out other kinds of protests. In 1886, the government passed the Crofters' Holdings Act to give the crofters some basic land rights.

Ewen A. Cameron

Highlands. See Scotland (Land regions).

Highsmith, Patricia (1921-1995), was an American writer known for her crime and suspense novels and short stories. Highsmith's novels reflect a psychological depth unusual in crime fiction. Many of her stories deal with the themes of guilt and the conflict between good and evil. Her works often center on a complex relationship between two men. She wrote in a dispassionate style that refused to judge the acts of her villains, sometimes portraying them in an almost sympathetic light.

Highsmith gained immediate recognition with her first novel, *Strangers on a Train* (1950). The plot deals with two men who meet on a train. Each man agrees to murder a person the other man hates. Highsmith also became known for a series of novels about a charming but evil young American named Tom Ripley. She introduced the character in *The Talented Mr. Ripley* (1955). He also appears in the novels *Ripley Under Ground* (1970), *Ripley's Game* (1974), *The Boy Who Followed Ripley* (1980), and *Ripley Under Water* (1991). Several of Highsmith's novels became successful motion pictures, including *Strangers on a Train* (1951), directed by Alfred Hitchcock, and *The Talented Mr. Ripley* (1999).

Highsmith's other novels include *Deep Water* (1957), *The Tremor of Forgery* (1969), *A Dog's Ransom* (1972), and *Found in the Street* (1986). Her numerous short stories were collected in *The Selected Stories of Patricia Highsmith* (2001). Highsmith also wrote children's literature.

Mary Patricia Plangman was born on Jan. 19, 1921, in Fort Worth, Texas. She eventually took her stepfather's last name, Highsmith. She graduated from Barnard College in 1942 and lived most of her adult life in Europe. Highsmith's reputation as a writer was much higher there than in the United States. European critics considered Highsmith a gifted novelist beyond the crime and suspense form. Jon L. Breen

Highway. See Road.

Higuchi Ichiyo, *hee goo chee ee chee yoh* (1872-1896), was the first modern woman writer in Japanese literature. Her stories show the influence of the lyricism of classical Japanese literature combined with the realism of Ihara Saikaku, a major Japanese fiction writer of the 1600's. Like Saikaku, Ichiyo chronicled the lives of average people living in cities.

Higuchi Natsuko was born on May 2, 1872, in Tokyo. She adopted the pen name Higuchi Ichiyo in 1891. She began to publish stories in magazines in 1892. Ichiyo's early stories were highly melodramatic and romantic. Her masterpiece, the short novel *Takekurabe* (known by several names in English, including *Comparing Heights, Growing Up,* and *Child's Play*), was published in installments in 1895 and 1896. It tells a realistic story of the loss of innocence of children growing up in the prostitution district of Tokyo. The children in the story gradually realize that they cannot choose how they will live as adults but must follow the roles assigned them by society.

Ichiyo died at the age of 24 from tuberculosis. Her work brought her fame in the months before her death.

Laurel Rasplica Rodd

Hijacking is the seizure of a commercial vehicle by force or the threat of force. For years, trucks have been hijacked and their cargo stolen. Today, hijacking involves chiefly airplanes and is also called *skyjacking* or *air piracy.* Since the late 1960's, skyjackers have seized

several hundred planes. In most of these incidents, no one was killed. But several skyjackings resulted in deaths and the destruction of aircraft. A number of governments impose severe penalties for skyjacking.

Plane hijackers may threaten to destroy an aircraft, kill the people aboard, or crash the aircraft into a heavily populated area. Some hijackers make political demands, such as certain policy changes by a nation's government or the release of imprisoned associates. Others demand a large sum of money in exchange for the safe return of the plane and the people aboard. Still other hijackers want to flee a country in order to escape punishment for a crime.

Gangsters frequently hijacked truckloads of liquor from one another in the 1920's and early 1930's, when alcoholic beverages were prohibited in the United States. One of the first skyjackings took place in 1930 in Peru. Skyjackings in the United States began in 1961, and a record total of 40 attempts occurred in 1969. In 1970, the airlines began a voluntary program of skyjack prevention. In 1973, the U.S. government began to require inspection of all passengers and other security action to prevent armed people from boarding planes.

On Sept. 11, 2001, skyjackers staged the worst terrorist attack in U.S. history. Terrorists hijacked four commercial airplanes. They crashed two planes into the two 110-story towers of the World Trade Center in New York City, and another into the Pentagon Building, just outside Washington, D.C. The other hijacked jet crashed in a field in Somerset County, Pennsylvania. The two towers collapsed to the ground, and part of the Pentagon was destroyed. Thousands of people were killed.

The domestic law of most nations considers the hijacking of a transnational airliner to be a crime. The Hague Convention of 1970 is a treaty providing international law for the trial and punishment of skyjackers. About 130 nations, including the United States and Canada, have agreed to support the treaty. Edwin B. Firmage

See also **Airport** (Airport security; picture: Security checks at airports); **Terrorism.**

Hiking is a healthful form of exercise and recreation. A hike can last for a few hours or for several weeks. Many experienced hikers find special pleasure in wilderness areas in national parks and national forests, and foreign places. However, numerous people prefer to hike in local parks or forest preserves—or even on city sidewalks. Walking for pleasure is the most basic form of hiking and ranks among the most popular recreation activities.

For most hiking, people need only clothing suitable for the weather, including comfortable shoes or lightweight boots. Beginning hikers should start with walks that last no longer than a day. As their endurance increases, they may take overnight hikes. Eventually, they may go on camping trips that last for several days or weeks.

A hiker can help provide for his or her safety by always having at least one companion. Hikers should be prepared for sudden changes in the weather. In addition, they should know basic first-aid skills so that they can treat such conditions as blisters and frostbite. Skill in using a map and a compass can be important when hiking in unfamiliar areas.

In *backpacking,* one of the most popular types of hiking, people carry food, clothing, and other items on their backs. Backpackers can spend many days in remote areas where supplies are unavailable.

A hiking sport called *orienteering* involves map reading and using a compass. Hikers compete over an established cross-country course. With a map and a compass, they must locate checkpoints scattered along the course. The person who finds all the checkpoints first is the winner.

During the winter, many hikers enjoy two cross-country sports, *cross-country skiing* and *snowshoeing.* Cross-country skiing, for which a person should receive professional instruction, is hiking on skis over snow. In snowshoeing, which requires no special training, hikers wear snowshoes. See **Skiing** (Nordic skiing).

Mountain climbing, also called *mountaineering,* is a special type of hiking that can be both difficult and dangerous. Hikers should take a course in mountaineering before attempting a climb, and they should always be accompanied by an experienced climber.

Many organizations, including the Boy Scouts, Girl Scouts, and local hiking clubs, provide information for hikers. Rangers at national parks and national forests provide maps and other aids. William R. Ruskin

See also **Camping; National Park System** (Visiting the parklands).

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Hill is an elevation of the earth's surface that has a distinct summit. It has much less surface area than a mountain and is lower in elevation. Hills rise less than 1,000 feet (305 meters) above the surrounding area. Mountains always exceed that height. However, a hill is not simply a small mountain. It is formed in a considerably different way.

Hills may be classified according to the way they were formed and the kinds of materials they are made of. There are two types, constructional and destructional. *Constructional hills* are created by a build-up of rock debris or sand deposited by glaciers and wind. Oval-shaped landforms called *drumlins* and sand dunes are examples of this type. *Destructional hills* are shaped by the deep erosion of areas that were raised by disturbances in the earth's crust. Such hills may consist of limestone overlying layers of more easily eroded rock.

M. Dane Picard

See also **Butte.**

Hill, Graham (1929-1975), became a leading automobile racing driver. An Englishman, Hill won racing's world title in 1962 by earning the most points in the nine Grand Prix races that made up the championship circuit that year. He was runner-up for the world title from 1963 through 1966, and won the title again in 1968. Hill won the Indianapolis 500 in 1966, the first time he entered the event.

Hill was born in London. He began racing in 1957, for the Lotus car builders. In 1960, he started driving for

British Racing Motors. Known for his humor, Hill liked to claim he learned much about driving from his troubles with an old car. He said the brakes failed so often he became skilled at stopping the car by scraping the tires against the curb. In 1975, Hill was killed in an airplane crash. Sylvia Wilkinson

Hill, James Jerome (1838-1916), was a famous businessman. He earned the name "Empire Builder" for his work in developing the area of the United States that lies between the Great Lakes and the Pacific Northwest. His energy and foresight in laying out a great transportation system played an important part in turning this unsettled region of the United States into a land of progress and prosperity.

Hill was born near Rockwood, Ontario. His father's death forced him to go to work at an early age. When he was 16, he went to St. Paul, Minnesota, and took a job with a steamboat company. At 25, he became an agent for the Northwestern Packet Company, and five years later organized the Red River Transportation Company. This was the first in a series of enterprises that led to completion of the Great Northern Railway. This railway, completed in 1893, combined existing lines and new construction. It ran from Lake Superior to Puget Sound, Washington. It was the first transcontinental railroad built without government aid. Hill later founded a steamship line offering the first direct transportation between the United States and the Orient.

In 1901, Hill and Edward Henry Harriman struggled to gain control of the Northern Pacific Railroad. The battle ended without a decisive victory for either man. Hill was also a fluent speaker and writer. His best-known work is *Highways of Progress* (1910). Robert C. Post

Hill, Joe (1879-1915), was a Swedish-born songwriter who popularized the goals of the American labor movement through his music. Hill's real name was Joel Hägglund. He was born in Gävle, Sweden. In 1902, he moved to the United States, where he roamed from place to place working at various jobs.

About 1910, Hill joined the Industrial Workers of the World (IWW), a labor organization that wanted to replace the American economic system with a society run by workers. Hill spread the IWW's beliefs by writing new lyrics for popular tunes. His best-known songs included "Casey Jones—The Union Scab" and "The Preacher and the Slave."

In 1914, a jury in Salt Lake City, Utah, convicted Hill of murdering two men and sentenced him to death. During his appeal, concerned people throughout the world protested the sentence. President Woodrow Wilson and the Swedish government tried to save his life, but Hill was executed by a firing squad. His casual lifestyle, his musical tributes to workers, and his dramatic death made him an American folk hero. Warren Van Tine

Hill, Octavia, *ahk TAY vih uh* (1838-1912), a British housing reformer, was equally interested in painting and social work when young. At the age of 14, she managed a workshop for poor girls, but it was through her painting that she became a pupil of the famous art critic, John Ruskin. Ruskin bought some slum property in 1864, and put her in charge. She improved the property and gave the tenants cultural advantages. In time, she managed property for over 3,000 people.

Hill believed that housing conditions could be improved only if those living in them were helped to appreciate finer things. She served on the Central Council of the Charity Organization Society and the Royal Commission on the Poor Laws. But she distrusted organized charity, and emphasized personal relationships, businesslike practices, and self-help. A believer in beauty and recreation, she did much to establish and preserve London's "green belt" of parks and playgrounds. Hill was born in London. Alan Keith-Lucas

Hillary, *HIHL uh ree,* **Sir Edmund Percival** (1919-), a New Zealand mountain climber, became one of the first two men to reach the top of Mount Everest and return. On May 29, 1953, he and Tenzing Norgay, a Sherpa tribesman from Nepal, reached the 29,035-foot (8,850-meter) summit (see **Mount Everest**). Queen Elizabeth II knighted Hillary for the achievement.

Hillary made his first five expeditions on Himalayan peaks after World War II. He climbed part of the way up

AP/Wide World

Sir Edmund Hillary, *far left,* a New Zealand mountain climber, was one of the first two men to reach the top of Mount Everest. He made the climb in 1953 with Tenzing Norgay, *right,* a Sherpa tribesman from Nepal.

Everest in 1951 and 1952. He wrote *High Adventure* (1955), an account of the 1953 climb. In 1957 and 1958, he blazed a trail from McMurdo Sound to the South Pole for Sir Vivian Fuchs's transantarctic expedition (see Antarctica [Recent activities]).

In 1960, Hillary headed an expedition, which was sponsored by *The World Book Encyclopedia,* to climb 27,824-foot (8,481-meter) Mount Makalu I. The expedition tested the ability of human beings to live without oxygen at high altitudes. The climbers also searched for but did not find evidence of the Abominable Snowman. With Desmond Doig, Hillary wrote *High in the Thin Cold Air* (1962) about this climb (see **Abominable Snowman**). Hillary was born in Auckland, New Zealand. His first job was beekeeping. Richard F. Dempewolff

See also **Tenzing Norgay.**

Hillel I, *HIHL ehl* (70 B.C.?-A.D. 10?), was the most prominent spiritual leader among the Jews of Palestine from 30 B.C. until his death. He was called Hillel the Elder and was known for his humility and his love for others. Hillel described the meaning of Judaism in simple terms. He said: "What is hateful to thee, do not unto thy fellowman; this is the whole Law; the rest is mere commentary."

A descendant of the house of David, Hillel was born in Babylonia. He settled in Palestine and studied with two great scholars, Shemaiah and Abtalion. He became an authority on interpreting Biblical law.

Because of his great learning, Hillel was made a prince of the Sanhedrin, the highest court in the Jewish state. In 30 B.C., he became president of this court, and he held office with distinction for 40 years. Hillel reorganized the extensive body of Jewish law. He made it easier to study by arranging the laws under six headings, where there had previously been 600. These six headings form the six major divisions of the *Talmud,* the book of Jewish laws. In addition, Hillel is described as the first sage to have devised logical rules for interpreting the scriptures.

Hillel founded a school, which was named for him. Thousands of students came to Jerusalem to study under him. Some of them became important enough to be mentioned in the Talmud, the Jewish book of civil, religious, and ethical laws. Hillel's chief rival was Shammai, who founded a more conservative school of interpretation. Some discussions on their differences in interpretation appear in the Talmud. Since 1923, the Hillel Foundation, a Jewish cultural youth movement, has set up branches at many universities. Gary G. Porton

Hillerman, Tony (1925-), is an American author whose works display a deep knowledge of Native American culture and tradition. Hillerman is best known for his series of detective novels featuring Navajo Indian tribal policemen Joe Leaphorn and Jim Chee.

Leaphorn is university educated and, in many ways, lives within mainstream American culture. He first appears as a solo detective in *The Blessing Way* (1970). The younger Chee has more interest in traditional Navajo ways. He is studying to become a *shaman* (religious leader) who performs traditional religious ceremonies and dances. *People of Darkness* (1980) is the first Chee novel. Leaphorn and Chee appear together in several books, including *Talking God* (1989), *Coyote Waits* (1990), *Sacred Clowns* (1993), *The Fallen Man* (1996), *The First Eagle* (1998), and *Hunting Badger* (1999).

Anthony Grove Hillerman was born in Sacred Heart, Oklahoma. He also wrote nonfiction about the Southwest, most notably *The Great Taos Bank Robbery, and Other Indian Country Affairs* (1973). Jon L. Breen

Hillman, Sidney (1887-1946), an American labor leader, was the guiding spirit of the Amalgamated Clothing Workers of America. He became the first president of the union in 1914. Under Hillman's leadership, it pioneered in constructive union-management relations. In addition, the union led in developing health and welfare programs and unemployment insurance, and it founded two banks and an insurance company.

Hillman helped found the Committee for Industrial Organization in 1935. When the committee became the Congress of Industrial Organizations (CIO) in 1938, he was one of the vice presidents. In 1943, he became chairman of the CIO Political Action Committee.

Hillman held posts on the National Industrial Recovery Board (1934), National Defense Advisory Council (1940), and in the Office of Production Management during World War II. He was born in Žagarė, Lithuania. He moved to the United States when he was 20 years old. Jack Barbash

Hills, Carla Anderson (1934-), served as United States secretary of housing and urban development from 1975 to 1977. Hills, who served in the post under President Gerald R. Ford, was the third woman Cabinet member in the nation's history. The others were Frances Perkins and Oveta Culp Hobby. As secretary of housing and urban development, Hills worked to help the nation's housing industry recover from an economic slump of the 1970's. She also directed programs to improve housing and living conditions in numerous communities.

AP/Wide World

Carla Anderson Hills

Hills was born in Los Angeles. She graduated from Stanford University in 1955 and received a law degree from Yale University in 1958. From 1962 to 1974, she was a member of a Los Angeles law firm. Hills then served as an assistant U.S. attorney general and head of the Civil Division of the Department of Justice until Ford appointed her to the Cabinet post. From 1989 to 1993, Hills was U.S. special trade representative under President George H. W. Bush. In this position, she played a major role in negotiating the North American Free Trade Agreement (NAFTA), which provided for the elimination of tariffs and certain other trade barriers between the United States, Mexico, and Canada. William J. Eaton

Hillyer, *HIHL yuhr,* Robert Silliman, *SIHL ih muhn* (1895-1961), an American poet, won the 1934 Pulitzer Prize for poetry for his *Collected Verse* (1933). He was an expert craftsman, writing in a variety of difficult poetic forms. His subjects include tributes to his friends and to poets he admired, lyric descriptions of the seasons in New England, and his experiences as an amateur yachtsman. Hillyer's poetry has a gentle, sophisticated tone that reflects a sly sense of humor and self-mockery. He

also wrote novels and literary criticism.

Hillyer was born in East Orange, New Jersey, and taught at Harvard University from 1919 to 1945. During the late 1940's, he aroused great controversy by attacking the poets T. S. Eliot and Ezra Pound. He wrote that these poets and their followers had rejected what was most important in American life and had adopted positions that were dangerously undemocratic.

Elmer W. Borklund

Hilo, *HEE loh* (pop. 40,759), is the largest city and chief port on the island of Hawaii. It lies on Hilo Bay, on the east side of the island (see Hawaii [political map]). For the monthly weather in Hilo, see Hawaii (Climate).

Hilo is the seat of Hawaii County and the home of a campus of the University of Hawaii. It exports flowers and nursery products, ginger, guava, macadamia nuts, and papaya. Hilo is the center of Hawaii's orchid-growing and flower-packaging industries. It lies near Kilauea, a volcano in Hawaii Volcanoes National Park. Kilauea is one of the world's most active volcanoes.

Polynesians settled in the Hilo area thousands of years ago. European missionaries settled there in 1824. In 1946 and 1960, after severe damage from huge, destructive waves called *tsunamis,* much of the city frontage was rebuilt farther inland. Eugene Tao

See also Kilauea; Mauna Kea; Mauna Loa.

Hilton, Conrad Nicholson (1887-1979), an American businessman, was sometimes called the "biggest hotel man in the world." He organized the Hilton Hotel Systems in 1946. In 1948, he started to build hotels in the cities of Berlin, Istanbul, Madrid, and Tokyo. By the mid-1960's, the system included over 40 hotels in the United States and 40 hotels in 37 other countries. In 1967, the international operations of the Hilton Hotel Corporation became a subsidiary of Trans World Airlines.

Hilton was born on Dec. 25, 1887, in San Antonio, New Mexico. He started his first hotel chain in Texas and New Mexico in 1918. He expanded to California in 1929, to New York in 1943, and to Chicago in 1945, where he bought the Stevens, then the world's largest hotel, and renamed it the Conrad Hilton. William H. Becker

Hilton, James (1900-1954), an English novelist, sprang to fame with *Good-bye, Mr. Chips* (1934). This sentimental short novel tells of a teacher in an English boys school. *Mr. Chips* brought attention to an earlier Hilton novel, *Lost Horizon* (1933). This work is the story of a group of people who become stranded in *Shangri-La,* a peaceful Tibetan mountain retreat where no one grows old. Hilton never quite repeated these early successes, though, like his earlier two novels, *Random Harvest* (1941) became a popular motion picture.

Hilton was born on Sept. 9, 1900, in Leigh, Lancashire. He came to live in the United States in the mid-1930's. He spent most of his time in Hollywood. Hilton shared the Academy Award for best screenplay for his work on the motion picture *Mrs. Miniver* (1942). Garrett Stewart

Himalaya, *HIH muh LAY uh* or *hih MAHL yuh,* also called Himalayas, is the highest mountain system in the world. The name *Himalaya* means the *House of Snow,* or the *Snowy Range,* in Sanskrit. The Himalaya consists of several parallel mountain ranges.

The mountains extend in a 1,500-mile (2,410-kilometer) curve across southern Asia from the Pamirs, west of the great bend of the Indus River, eastward to the great

WORLD BOOK map

The Himalaya, the world's highest mountain range, forms a great natural barrier between the Tibetan plateau of China, and India and Nepal.

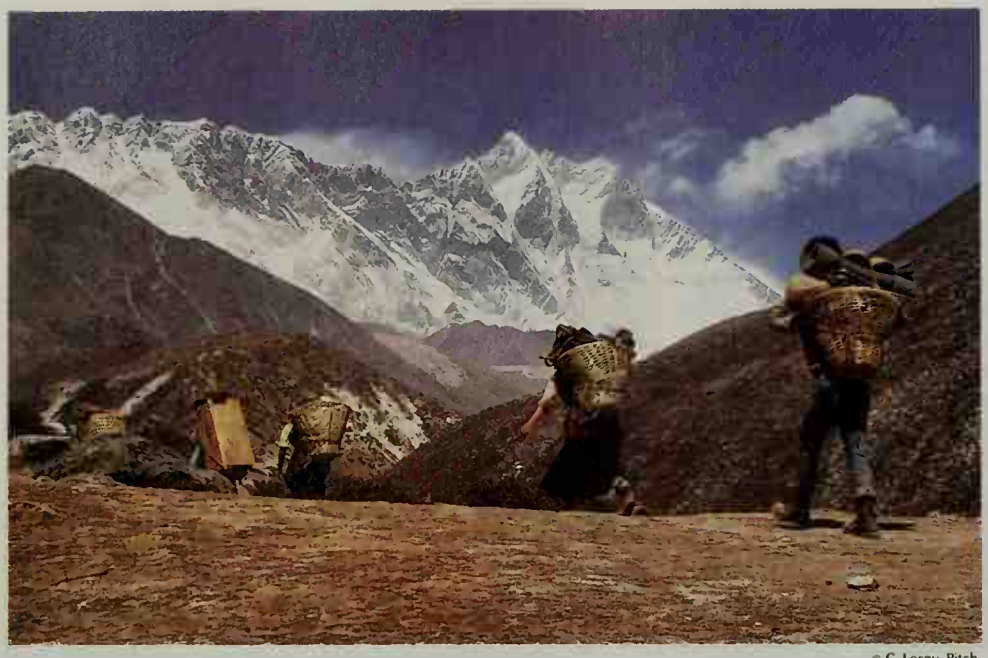
bend of the Brahmaputra River. They form a barrier that separates northern India from the plateau of Tibet, in China. Parts of the Himalayan system are as much as 200 miles (320 kilometers) wide. The Himalaya joins with other mountain ranges of Asia that stretch east and west. The Karakoram mountain system, which includes the Karakoram, or Mustagh, Range and three lesser ranges, is the northwestern extension of the Himalaya.

Peaks. The Himalaya rises in steps from the plains of northern India, which have an elevation of about 1,000 feet (300 meters) above sea level. Mount Everest (29,035 feet, or 8,850 meters), which lies between Tibet and Nepal, is the highest mountain in the world. K2 (28,250 feet, or 8,611 meters), in the Karakoram Range, is the world's second highest mountain.

One of the most famous peaks in the Himalaya is Mount Kailas (22,028 feet, or 6,714 meters), which lies in Tibet. The Tibetans call it Kang Rimpoche (the *Mountain of Precious Snow).* This mountain is holy to the Hindus and Buddhists and is said to contain the thrones of their gods. Pilgrims from all parts of central Asia and India climb the mountain. They usually climb on foot, and the journey takes them from tropical jungles to freezing heights. Lying below the peak is the holy Lake Manasarowar, where the pilgrims worship.

Kanchenjunga, or Kinchinjunga (28,208 feet, or 8,598 meters), the third highest mountain in the world, lies near Mount Everest. Other high peaks are Makalu I (27,824 feet, or 8,481 meters); Makalu II (25,130 feet, or 7,660 meters); Dhaulagiri (26,810 feet, or 8,172 meters); Nanga Parbat (26,660 feet, or 8,126 meters); and Mount Kamet (25,447 feet, or 7,756 meters).

Passes and glaciers. The passes that run through the Himalaya are among the highest in the world. Few of the passes are lower than 15,000 or 16,000 feet (4,570 or 4,880 meters) above sea level. Most are covered with snow from November to May and are then impossible



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Snow-capped Himalayan peaks in Nepal provide a dramatic view for these porters. Because of the rugged terrain, roads for vehicles have been impossible to build in many areas of the Himalaya, and goods must be transported on foot.

to cross. Many glaciers form in the high passes.

Climate and plant life. Almost every kind of climate can be found in the Himalaya because of the great difference in altitude in various parts of the range. This wide range in climate makes possible a variety of plant life. On the steep southern slopes grow tropical plants, such as the fig and palm tree. These plants are found up to a height of 3,000 feet (910 meters). Oak, chestnut, and laurel trees are common up to 7,000 feet (2,100 meters). Deodar and pine trees begin to appear at 12,000 feet (3,660 meters). Many shrubs and climbing plants are found in the forests. Rhododendrons grow on the mountain slopes. The tea plant is cultivated up to 5,000 feet (1,500 meters). On the southern slopes, rice, corn, and millet are grown up to 6,000 feet (1,800 meters). Wheat and barley are grown in slightly higher regions.

Animal life. The Himalaya has many animals that live in tropical, temperate, and cold regions. Tigers, leopards, rhinoceroses, elephants, yaks, and some kinds of monkeys are found there.

James A. Hafner

Related articles in *World Book* include:

Abominable Snowman
Annapurna
K2
Kashmir
Mount Everest
Mount Kanchenjunga
Mount Makalu
Nepal
Pamirs
Tibet
Yak

Himes, Chester (1909-1984), was an African-American writer best known for his detective fiction. Himes wrote 17 novels and many short stories.

Himes was born in Jefferson City, Missouri. In 1928, while living in Cleveland, he was convicted of armed robbery and sentenced to 20 to 25 years of hard labor in prison. There he began his writing career, publishing short stories that drew upon his own experiences for their grim portrayal of violent and despair-ridden lives. He was paroled in 1936.

Himes lived in California from 1940 to 1953. During this time he published his first three novels, largely autobiographical in style. They are *If He Hollers Let Him Go* (1945), *Lonely Crusade* (1947), and *Cast the First Stone* (1952). In 1953, he moved to France. There he published *For Love of Imabelle* (1957). This was the first of nine detective novels about Coffin Ed Johnson and Grave Digger Jones, two black policemen working in the Harlem area of New York City. The best known is *Cotton Comes to Harlem* (1964). Himes lived in Spain from 1969 until his death in 1984.

Himes's other notable novels include the satirical *Pinktoes* (1961) and the experimental *A Case of Rape* (1964). Sixty of his short stories were gathered as *The Collected Stories of Chester Himes* (published in 1990, after his death). Himes wrote a two-volume autobiography, *The Quality of Hurt* (1972) and *My Life of Absurdity* (1976).

Brad S. Born

Himmler, Heinrich (1900-1945), was one of the most powerful leaders of Nazi Germany. As the head of the German police, including the *Gestapo,* Himmler ordered the deaths of millions of people. These killings began with the "blood purge" of 1934 and ended with systematic killings in concentration camps that were operated by Himmler's *Schutzstaffel* troops, also referred to as the *S.S.*

Himmler was born in Munich. He was a follower of Adolf Hitler from the days of Hitler's unsuccessful attempt to gain power in 1923. Himmler became chief of police for all Germany in 1936, minister of the interior in 1943, and minister of home defense in 1944. He committed suicide after Allied troops captured him.

Otis C. Mitchell

Hinckley, John W., Jr. See **Reagan, Ronald W.** (Events at home).

Hincks, Sir Francis (1807-1885), was joint premier of the Province of Canada from 1851 to 1854. He and Augustin-N. Morin held office together. Their government promoted railroad construction during the early part of Canada's railway-building era. Hincks served as finance minister of the Dominion of Canada from 1869 to 1873. He played a key role in the passage of the Bank Act of 1871, which established government regulation of Canada's banking system.

Hincks was born in Cork, Ireland. He moved to York

(now Toronto), Canada, in 1830 and became manager of the People's Bank there in 1835. In 1838, he founded a newspaper, the *Examiner,* in Toronto. In 1841, Hincks was elected to the first Legislative Assembly of the Province of Canada. He also served as inspector-general in several administrations, including his own.

In 1855, the British government appointed Hincks governor of Barbados and the Windward Islands. In 1862, he became governor of British Guiana (now Guyana). He was knighted in 1869. From 1873 to 1879, he was president of the City Bank of Montreal. P. B. Waite

Hindemith, *HIHN duh muhth* or *HIHN duh mihth,* **Paul** (1895-1963), was a German American composer and music theorist. His compositions are noted for their use of musical forms of the past, a new approach to tonal harmony, and contrapuntal textures (see Counterpoint). Many of his works belong to the Neoclassical style that emerged after World War I (1914-1918).

Hindemith wrote many sonatas for orchestral instruments, including such rarely featured instruments as the double bass, trombone, and tuba. He also wrote concertos for cello, clarinet, organ, piano, and violin, as well as concertos for such combinations of instruments as the trumpet and the bassoon. Hindemith's other orchestral works include seven pieces called *Kammermusik* (Chamber Music, 1922-1927) for various solo instruments and small orchestra. Hindemith's opera *Mathis der Maler* (1938) explores the role of the artist in society. He made the instrumental portions into a symphony (1934), which became one of his best-known works. Hindemith explained his system of music theory in *The Craft of Musical Composition* (1937, 1939, revised 1945).

Hindemith was born in Hanau, Germany. He taught at Yale University from 1940 to 1953 and became a United States citizen in 1946. While at Yale, he organized a *collegium musicum,* a group of musicians devoted to performing older music. This group made a significant impact on the revival of interest in early music during the mid-1900's. Daniel T. Politoske

Hindenburg. See Airship (The Hindenburg; picture).

Hindenburg, *HIHN duhn behrg* or *HIHN duhn burk,* **Paul von** (1847-1934), was a German soldier and statesman. He was military leader of Germany during World War I (1914-1918), and he served as president of Germany from 1925 until his death. Hindenburg appointed Adolf Hitler chancellor in 1933, and Hitler became ruler of Germany.

Hindenburg was born in Posen, East Prussia (now Poznań, Poland). He served as a junior officer in Prussian military victories over Austria in 1866 and France in 1870 and 1871. Hindenburg became a general in 1896, and he retired in 1911. When World War I began, Hindenburg came out of retirement to command the German Eighth Army. General Erich Ludendorff became his chief of staff. In the fall of 1914, Hindenburg and Ludendorff won important victories over Russian forces in East Prussia. Hindenburg was promoted to field marshal and became commander in chief on the eastern front. In 1916, he became supreme commander of all German forces and one of the most powerful men in Germany. Ludendorff, whom many historians consider a better strategist, remained Hindenburg's second in command.

Early in 1917, Hindenburg and Ludendorff ordered the Siegfried Line built in northeastern France, to shorten the western front and to ease the strain on Germany's troops. Germany held this line from March 1917 until the Allies broke through at the end of the war in September 1918. The Allies called it the Hindenburg Line. See World War I (The final stage).

Hindenburg was elected president of Germany in 1925 and reelected in 1932. The Great Depression in 1929 caused unemployment and unrest in Germany and led to support for Hitler's Nazi Party. In the elections of 1932, the Nazi Party showed that it had become the strongest party in Germany. Hitler claimed the support of a majority of parliament. Hindenburg became increasingly influenced by advisers who supported the Nazis. The aged and tiring Hindenburg finally appointed Hitler chancellor on Jan. 30, 1933. After Hindenburg died in 1934, Hitler abolished the presidency and assumed its powers. Donald M. McKale

See also Hitler, Adolf (Rise of the Nazis; picture).

Hindenburg Line. See Siegfried Line.

Hindi, *HIHN dee,* is one of the official languages of India. More Indians speak Hindi than any other language. In a broader sense, the word *Hindi* refers to a group of languages spoken in north central India. Modern Hindi developed from a dialect called Khari Boli but includes elements of Sanskrit, an ancient Indian language. During the 1800's, when the British controlled much of India, they encouraged the Indians to systematize Hindi. Today, the Indian government promotes Hindi as a national language. Frank E. Reynolds

See also India (Languages); Alphabet (picture: Some important alphabets).

Hindu Kush, *HIHN doo KUSH,* is a chain of mountains in Central Asia. For location, see Afghanistan (map). The name *kush* means death. It was probably given to the mountains because of their dangerous passes. The Hindu Kush were called the Caucasus by historians of Alexander the Great. The mountains are a westward continuation of a region called the Pamirs (see Pamirs).

For 500 miles (800 kilometers), the Hindu Kush form a great *watershed,* or water divide, between the Indus and Amu Darya rivers. The mountains form part of the boundary between eastern Afghanistan and northwestern Pakistan. The highest peak in the range is Tirich Mir (25,230 feet, or 7,690 meters). Timur (also called Tamerlane), a Mongol leader who lived in the 1300's and early 1400's, reportedly tried to cross these mountains. Riffat Sardar

Hinduism, the major religion of India, is one of the oldest living religions in the world. The roots of Hinduism date to prehistoric times in India. About 750 million people practice Hinduism. Although most Hindus live in India, Hindu literature and philosophy have influenced people throughout the world.

Through the centuries, Hinduism has been the most important influence on the culture of India. For example, the caste system of India is a basic part of Hinduism. The caste system determines the way of life of most Hindus, including what occupations they enter.

Beliefs of Hinduism

Hinduism developed gradually over thousands of years, and many cultures and religions helped shape it. Many *sects* (groups) arose within Hinduism, and each developed its own philosophy and form of worship. Like

Edward S. Ross

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Hinduism has numerous sacred writings, and its believers worship many gods and goddesses. The priests shown at the left are reading from the *Rigveda,* the oldest sacred book in Hinduism. At the right, Hindus are praying before an image of the many-armed goddess known as Durga or Kali. This divinity is the wife of the god Shiva. She is worshiped as the feared goddess of destruction.

most religions, Hinduism has basic beliefs about divinities, life after death, and personal conduct.

Sacred writings. Hinduism has no single book that is the source of its doctrines. But it has many sacred writings, all of which have contributed to its fundamental beliefs. The most important include the *Vedas,* the *Puranas,* the *Ramayana,* the *Mahabharata* with its section called the *Bhagavad-Gita,* and the *Manu Smriti.*

The Vedas are the oldest Hindu scriptures and are older than the sacred writings of any other major religion. The teachings of the *Vedas* existed for centuries before they were finally written down. There are four *Vedas*—the *Rigveda,* the *Samaveda,* the *Yajurveda,* and the *Atharvaveda.* Each has four parts—the *Samhitas,* the *Brahmanas,* the *Aranyakas,* and the *Upanishads.* The *Samhitas* contain prayers and hymns and are the oldest part. The *Brahmanas* deal with ritual and theology and include explanations of the *Samhitas.* The *Aranyakas* and the *Upanishads* are works of mysticism and philosophy written as dialogues.

The Puranas are long verse stories that contain many important Hindu myths about Hindu gods and goddesses and the lives of great Hindu heroes. They also describe the Hindu beliefs about how the world began and how it periodically ends and is reborn.

The Ramayana and the Mahabharata are long epics. The *Ramayana* tells of Prince Rama and his attempts to rescue Sita, who has been kidnapped by the demon king Ravana. The *Mahabharata* describes a conflict between the Pandavas and the Kauravas, two families who are cousins. Generally, the Pandavas are considered to be morally and ethically superior to the Kauravas.

The Bhagavad-Gita, a philosophical work, forms part of the *Mahabharata.* In it, the god Krishna and the Pandava warrior Arjuna discuss the meaning and nature of existence.

The Manu Smriti (*Code of Manu*) is a basic source of Hindu religious and social law. Part of the Manu Smriti sets forth the basis of the caste system.

Divinities. Early Hindus worshiped gods that represented powers in nature, such as rain and the sun. Gradually, some Hindus came to believe that, though divinities appear in separate forms, these forms are part of one universal spirit called *Brahman.* These Hindus believe that many divinities make up Brahman. The most important ones are Brahma, the creator of the universe; Vishnu, its preserver; and Shiva, its destroyer.

One of the most important Hindu divinities is Shiva's wife, who has several names. She is best known as Durga, Kali, Parvati, or Uma. As Parvati or Uma, she is the beloved goddess of motherhood. As Durga or Kali, she is the feared goddess of destruction. For many Hindus, these contrasting natures of the goddess represent the way in which time and matter constantly move from birth to death and from creation to destruction. Many Hindus find great religious truth in this symbolism and worship the goddess as their most important divinity.

According to Hindu doctrine, animals as well as human beings have souls. Hindus worship some gods in the form of animals. Cows are sacred, but Hindus also revere monkeys, snakes, and other animals.

The six schools of philosophy. Many schools of Hindu thought have developed through the centuries. Six of these schools have become especially prominent. In their traditional order, they are (1) *nyaya,* (2) *vaisheska,* (3) *sankhya,* (4) *yoga,* (5) *purva-mimamsa,* and (6) *vedanta.*

Nyaya deals with logic. Vaisheska concerns the nature of the world. Sankhya examines the origin and evolution of the universe. Yoga is a set of mental and physical exercises designed to free the soul from reliance on the body so that the soul can unite with Brahman. Purva-mimamsa categorizes Vedic texts and rituals. Vedanta interprets especially the *Upanishads,* the *Bhagavad-Gita,* and the *Brahma Sutra.*

Caste is India's strict system of social classes. The caste system may have existed in some form before

Aryan invaders from central Asia attacked India about 1500 B.C. The Aryans or their descendants gradually gained control of most of India. They used the caste system at first to limit contact between themselves and the native Indian people. Later, the caste system became more elaborate and one of the teachings of Hinduism. The Hindu castes are grouped into four main categories, called *varnas.* In order of rank, these hereditary groups are (1) *Brahmans,* the priests and scholars; (2) *Kshatriyas,* the rulers and warriors; (3) *Vaisyas,* the merchants and professionals; and (4) *Sudras,* the laborers and servants. The caste system includes thousands of castes, each of which has its own rules of behavior.

The sacred word *om* is repeated many times by a Hindu while meditating. The written form of the word in the Sanskrit language of India, shown here, is a symbol of Hinduism.

For centuries, one large group, the *untouchables,* has existed outside the four varnas and has ranked below the lowest Sudra caste. The untouchables traditionally have had such occupations as tanning, which Hindu law forbids for a member of any caste in the four varnas. The Indian constitution of 1950 outlawed untouchability and gave the group full citizenship. But discrimination against untouchables has not been eliminated.

Through the years, the caste system has weakened somewhat, but continues to be a strong influence in Indian life. Some social distinctions have been abandoned, especially in the cities. Many educated Hindus of different castes intermix and work with one another. Formerly, they would have dined with and would have married only members of their own caste.

Reincarnation and karma. Hinduism teaches that the soul never dies. When the body dies, the soul is reborn. This continuous process of rebirth is called *reincarnation.* The soul may be reborn in an animal or in a human being, but Hindu doctrine is not clear on this point.

The law of *karma* states that every action influences how the soul will be born in the next reincarnation. If a person lives a good life, the soul will be born into a higher state, perhaps into the body of a brahman. If a person leads an evil life, the soul will be born into a lower state, perhaps into the body of a worm. A person's reincarnation continues until he or she achieves spiritual perfection. The soul then enters a new level of existence, called *moksha,* from which it never returns.

Hindu worship

Worship in temples. Hinduism considers temples as buildings dedicated to divinities. Its followers worship as individuals, not as congregations. Most Hindu temples have many shrines, each of which is devoted to a divinity. Each temple also has one principal shrine devoted to a single important god or goddess.

The shrines portray the divinities in sculptured images. Hindus treat these images as living human beings. Every day, for example, priests wash and dress the images and bring them food. Hindus do not consider this custom idol worship. They believe the divinities are actually present in the images.

Hindu temples hold annual festivals commemorating events in the lives of the divinities. Huge crowds gather for these festivals. They come to worship, to pray for assistance, and to enjoy the pageantry of the event. Millions of Hindus visit temples along the Ganges River, the most sacred river in India.

Worship in the home. Many observances of Hinduism take place in the home. Most homes have a shrine devoted to a divinity chosen by the family. In most homes, the husband or wife conducts the daily family worship. A number of important ceremonies are performed at home, including the one in which boys officially become members of the Hindu community. Other religious ceremonies include marriage ceremonies and rituals that are connected with pregnancy and childbirth.

Worship of saints. Hindus worship both living and dead men as saints. Some saints may be *yogis* (men who practice yoga), and others may be *gurus* (spiritual teachers). Hinduism has many local and regional saints, rather than official saints for all its followers. A Hindu village, tribe, or religious order may elevate its own heroes or protectors to sainthood. Many Hindu monks and nuns have joined together in religious orders under the leadership of a saint.

Charles S. J. White

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Brahman	Krishna	Suttee
Caste	Mahabharata	Upanishads
Dharma	Manu	Vedas
Ganges River	Rama	Vishnu
India	Ramayana	Yoga

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Hines, Earl (1903-1983), also called "Fatha" Hines, was an outstanding American jazz pianist and bandleader. His method of piano playing was often called *trumpet style,* because its frequent use of single note phrases and *arpeggios* (fast successions of notes in a chord) resembled the style of jazz brass players.

Earl Kenneth Hines was born in Duquesne, Pennsylvania. He initially studied trumpet but switched to the piano. Hines was first taught piano by his stepmother. He then studied with various teachers in Pittsburgh.

Hines began his professional music career as an accompanist. In 1924, he moved to Chicago, then an important center for outstanding jazz musicians. After playing with several bands in Chicago, Hines met trumpeter Louis Armstrong. In 1928, the two artists made several records together that remain jazz classics, including "West End Blues" and "Weather Bird." Also in 1928, Hines made several famous jazz records with a small band led by clarinet player Jimmy Noone. One of the most notable of these records was "Apex Blues."

In 1928, Hines formed his own band, which played at the Grand Terrace ballroom in Chicago for 12 years. The

band became famous through radio broadcasts and nationwide tours. Many important young musicians played in the band at one time or another, including saxophonist Charlie Parker and trumpeter Dizzy Gillespie, as well as singers Billy Eckstine and Sarah Vaughan. From 1948 to 1951, Hines played with Armstrong's group, the All Stars. After then, Hines played with small groups in relative obscurity through the early 1960's. In 1964, Hines performed in a series of concerts in New York City that revived his career. He then performed regularly with his own small groups until his death. Eddie Cook

Hingis, Martina (1980-), became the youngest tennis player to win a grand slam singles championship since 1887. She won the 1997 Australian Open women's singles title at age 16. Hingis ranked as the number-one female player in the world in 1997. That year, she won 75 of 80 matches, including three of the four grand slam events—the Australian Open, the United States Open, and the All-England (Wimbledon) championship. Hingis also won the women's singles titles at the Australian Open in 1998 and 1999. She won the women's doubles championship at the Australian Open with Mirjana Lucic of Croatia in 1998 and with Anna Kournikova of Russia in 1999 and 2002, at the French Open with Jana Novotna of the Czech Republic in 1998 and Mary Pierce of France in 2000, and at the U.S. Open and Wimbledon with Novotna in 1998.

Hingis was born on Sept. 30, 1980, in Košice, Czechoslovakia (now Slovakia). She was named after Martina Navratilova, a Czechoslovak-born tennis star. Hingis entered her first tournament when she was 5 years old. She moved to Switzerland when she was 7. In 1996, Hingis became the youngest player ever to win a Wimbledon event when she won the women's doubles title with Helena Sukova of the Czech Republic.

Dave Nightingale

Hinny. See **Donkey; Mule.**

Hinton, S. E. (1948-), is an American writer of novels for young adults. She writes about teen-agers who face such problems as violence, poverty, and alcohol and drug abuse. The young characters in her novels often reject authority while wrestling with these problems.

Susan Eloise Hinton was born and raised in Tulsa, Oklahoma. The Tulsa area became the setting for her novels. Hinton's first and probably best-known book is *The Outsiders,* written when she was 16 and published in 1967. It is a story about two rival gangs, one rich and one poor. The book is noted for its action-packed plot, believable characters, and realistic language.

Hinton's second novel, *That Was Then, This Is Now* (1971), focuses on teen-age boys and the problems of growing up, especially the problem of drug abuse. *Rumble Fish* (1975) tells the story of a 14-year-old boy who idolizes his older brother, a former gang leader. His efforts to be like his brother get him into serious trouble. *Tex* (1979) also deals with two brothers, ages 14 and 17. Their father abandons them, and tensions grow between them as the younger brother tries to become more independent. *Taming the Star Runner* (1988) is an account of a 16-year-old boy who wants to become a writer and his relationship with an 18-year-old horse trainer and her horse. Marilyn Fain Apseloff

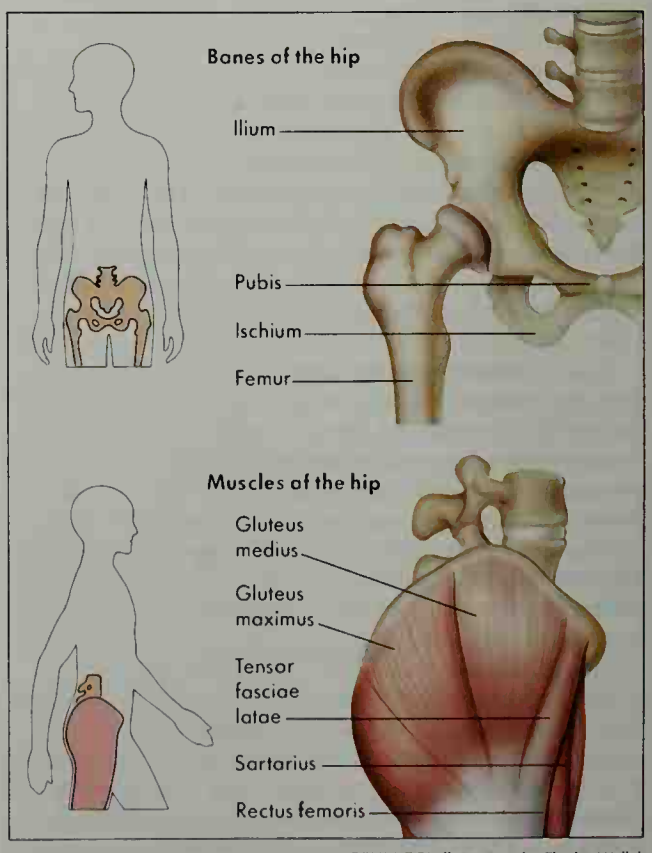
Hip is the region of the body between the trunk and the thigh. The hip joint is formed by the hipbone—which consists of three united bones, the *ilium, ischium,* and *pubis*—and the head of the *femur* (thighbone). The head of the femur fits into the *acetabulum,* a socket in the hipbone. This arrangement forms a ball-and-socket joint, which provides great strength and allows a wide range of motion in all directions. Several muscles surround the joint. These muscles make the joint firm so a person can stand. They also move the leg for walking and running.

Many children are born with a hip socket that is too shallow and bones that are not aligned properly. This condition is called *congenital dislocation* of the hip. In old age, the neck of the femur, located just below the head of the femur, becomes weak and breaks easily. The break can be repaired by fastening the head on the neck with a stainless steel nail or by replacing the head with a metal ball. Many arthritis victims suffer disabling pain in the hip joint. In such cases, the joint can be replaced by a plastic socket and a metal ball. James A. Hill

See also **Human body** (Trans-Vision picture).

Hipparchus, *hih PAHR kuhs* (? -514 B.C.), was a son of Pisistratus, a ruler of Athens in the 500's B.C. Hipparchus came to power with his brother Hippias in 527 B.C., after their father's death.

Hipparchus apparently let his brother control government matters while he concerned himself with cultural affairs. He brought such poets as Anacreon and Simonides to Athens. Hipparchus was killed during an attempt to overthrow the government. The attempt was led by two young nobles, Harmodius and Aristogiton, who intended to kill Hippias as well but failed. Another Athenian named Hipparchus, a member of the same family,



WORLD BOOK illustrations by Charles Wellek

The hip joint is a ball-and-socket arrangement that permits a wide range of movement in all directions. This illustration depicts the bones of the hip joint and their attached muscles.

was elected archon, or chief magistrate, in 496 B.C.
Jennifer Tolbert Roberts

Hipparchus, *hih PAHR kuhs* (180 B.C.?-125 B.C.?), an ancient Greek astronomer, is credited with discovering the *precession* (movement) of the equinoxes. The ancient Roman writer Pliny the Elder wrote that Hipparchus, excited by the appearance of a new star, studied earlier observations and noticed that the stars shifted eastward. He explained this shift by a slow forward motion of the equinoxes. See **Equinox.**

Hipparchus' study of precession was probably based on a more general study of the stars. He may have drawn up the first catalog of the stars, showing their brightness and position (see **Magnitude**). He was also concerned with plotting the relative motions of the sun and moon as accurately as possible. His work led to some important improvements in both solar and lunar theory. For example, he distinguished between two different lengths (tropical and sidereal) of year. From his observations of the unequal length of the year's four seasons, he derived a better account of the apparent movement of the sun. This account and Hipparchus' improved theory of lunar motion enabled him to predict eclipses more accurately. Hipparchus was born in Nicaea, near what is now Istanbul, Turkey. A. Mark Smith

Hippies were members of a youth movement of the 1960's and 1970's that started in the United States and spread to Canada, Great Britain, and many other countries. The hippies rejected the customs, traditions, and life styles of society and tried to develop those of their own. Most hippies came from white middle-class families and ranged in age from 15 to 25 years old. They thought too many adults cared about making money and little else. The term *hippie* may come from the word *hip,* which means *"tuned-in"* or *aware.*

Hippies wanted a world based on love of humanity and peace. Many believed that wonderful, magical changes were about to take place. They thought these changes would happen as soon as people learned to express their feelings honestly and to behave naturally at all times. Hippies strongly opposed U.S. involvement in the Vietnam War (1957-1975).

Many hippies lived together in small groups, working with one another and sharing possessions. Others refused to be tied down to a fixed job or home. They wandered from place to place seeking part-time work and temporary shelter. Some begged for spare change and lived in the streets or camped in parks or other public lands.

Hippies were sometimes called "flower children" because they gave people flowers to communicate gentleness and love. They let their hair grow long and walked barefoot or in sandals. Hippies attracted public attention by wearing clothing that featured unusual combinations of colors and textures. A large number of hippies used marijuana, LSD, and other drugs. Drug experiences shaped many of their symbols and ideas.

The Beatles, a popular English rock group, helped spread the hippie movement with their songs. Hippie favorites included such other rock groups as the Grateful Dead and the Jefferson Airplane, singers Joan Baez and Bob Dylan, poet Allen Ginsberg, and novelist Ken Kesey. Many hippies admired Timothy Leary, a psychologist who preached salvation through the use of drugs.

In time, most hippies realized it was not easy to reform society by "dropping out" of it. Some joined more organized political movements to work for specific social causes. Others turned to spirituality or religion. The majority simply left the hippie stage of their lives behind while trying to hold on to at least a few of the ideals that once inspired them. Benjamin Zablocki

See also **Baez, Joan; Beatles; Ginsberg, Allen.**

Hippocampus. See **Seahorse.**

Hippocrates, *hih PAHK ruh TEEZ* (460?-380? B.C.), was a well-known ancient physician who practiced medicine on the Greek island of Cos. Long after his death, Hippocrates became the most famous person in ancient medicine.

Hippocrates' fame probably resulted from about 80 anonymously written medical works that became part of the collection of the Library of Alexandria after about 200 B.C. Those writings became linked with Hippocrates and are known by scholars as the *Hippocratic corpus.* However, none of these "Hippocratic" works can be proved to have been written by Hippocrates.

Hippocrates is often called the father of medicine. This image of him emerged from the writings of Galen, a great physician who lived during the A.D. 100's and 200's. Galen believed that the life and practice of Hippocrates represented all that was good in medicine. For example, a Hippocratic tract called *Nature of Man* maintained that illness was caused by an imbalance of four

The Hippocratic oath

I swear by Apollo Physician and Asclepius and Hygieia and Panaceia and all the gods and goddesses, making them my witnesses, that I will fulfil according to my ability and judgment this oath and this covenant:

To hold him who has taught me this art as equal to my parents and to live my life in partnership with him, and if he is in need of money to give him a share of mine, and to regard his offspring as equal to my brothers in male lineage and to teach them this art—if they desire to learn it—without fee and covenant; to give a share of precepts and oral instruction and all the other learning to my sons and to the sons of him who has instructed me and to pupils who have signed the covenant and have taken an oath according to the medical law, but to no one else.

I will apply dietetic measures for the benefit of the sick according to my ability and judgment; I will keep them from harm and injustice.

I will neither give a deadly drug to anybody if asked for it, nor will I make a suggestion to this effect. Similarly I will not give to a woman an abortive remedy. In purity and holiness I will guard my life and my art.

I will not use the knife, not even on sufferers from stone, but will withdraw in favor of such men as are engaged in this work.

Whatever houses I may visit, I will come for the benefit of the sick, remaining free of all intentional injustice, of all mischief and in particular of sexual relations with both female and male persons, be they free or slaves.

What I may see or hear in the course of the treatment or even outside of the treatment in regard to the life of men, which on no account one must spread abroad, I will keep to myself holding such things shameful to be spoken about.

If I fulfil this oath and do not violate it, may it be granted to me to enjoy life and art, being honored with fame among all men for all time to come; if I transgress it and swear falsely, may the opposite of all this be my lot.

The Hippocratic Oath, No. 1 of the *Supplements to the Bulletin of the History of Medicine,* copyright 1943. Text, translation, and interpretation by Ludwig Edelstein. By permission of the Johns Hopkins University Press.

different *humors* (liquids) in the body—blood, black bile, yellow bile, and phlegm. This belief dominated theories of disease until the late 1800's. To Galen, the *Hippocratic oath* served as a model for the ethical practice of medicine. Today, many graduating medical students still take an oath modeled on this text.

Hippocratic medicine challenged the methods of many physicians who used magic and witchcraft to treat disease. It taught that diseases had natural causes and could therefore be studied and possibly cured according to the workings of nature. Under Hippocratic medicine, a well-trained physician could cure illness with knowledge gained from medical writings or from experience. Modern medicine is still based on this assumption.

Little is known for sure about Hippocrates' life. So-called facts about his birth, medical practice, and death are more attributable to myths or legends than to actual evidence. The earliest known biography of him is *Life of Hippocrates,* by Soranus, a Roman physician. This work was published about A.D. 100, more than 400 years after Hippocrates' death. John Scarborough

Hippodrome, *HIHP uh drohm,* is a place for horse and chariot races. The ancient Greeks built hippodromes with seats in rows, or tiers, like bleachers. The seats surrounded a long race course, and curved around one end of it. A wall in the center divided the course. It was usually from 600 to 800 feet (180 to 240 meters) long.

The largest Greek hippodrome was in Constantinople (now Istanbul). The Roman Circus Maximus, like all Roman circuses, was a copy of the Greek hippodromes. The Circus Maximus was the largest of the ancient Roman hippodromes. It seated about 250,000 spectators.

In more recent times, race tracks, indoor circuses, and amusement places have been called hippodromes. The New York Hippodrome was the largest indoor playhouse in the world until it closed in 1928. It could seat about 5,200 people at one time. Ronald P. Legon

Hippopotamus, *HIHP uh PAHT uh muhs,* is the third largest animal that lives on land. Only the elephant and rhinoceros are larger. A large, wild river hippopotamus may weigh as much as 5,800 pounds (2,630 kilograms).

Hippopotamuses live in central, southern, and western Africa. They live close to water and spend much time in it. The word *hippopotamus* comes from two Greek words meaning *river horse.* However, the hippopotamus is more closely related to the whale than to the horse. There are two kinds of hippopotamuses: (1) the *river hippopotamus,* also called the *common hippopotamus,* and (2) the *pygmy hippopotamus.* The pygmy hippopotamus is much smaller than the river hippopotamus. It is also rarer.

The body of a river hippopotamus. The river hippopotamus has a large, barrel-shaped body; short legs; and a huge head. It generally weighs from 2,500 to 3,000 pounds (1,130 to 1,400 kilograms) and stands about 5 feet (1.5 meters) tall. It ranges from 12 to 15 feet (4 to 5 meters) long, not including the tail, which measures about 22 inches (56 centimeters) long. Each foot has four webbed toes.

The eyes of the river hippopotamus stick out from its head. The position of the ears, eyes, and nostrils enables the animal to hear, see, and breathe with most of its head underwater. The hippopotamus can also close its nostrils and ears when it swims or dives. Hippopotamuses have a good sense of smell, but their vision is only fair.

River hippopotamuses have thick, brownish-gray skin. They have no hair except for a few bristles on the head and tail. Special glands in the skin give off a clear, oily fluid that is either pink or red. This fluid keeps the animal's skin from getting too dry. The reddish color of the fluid led to the mistaken belief that hippopotamuses sweat blood.

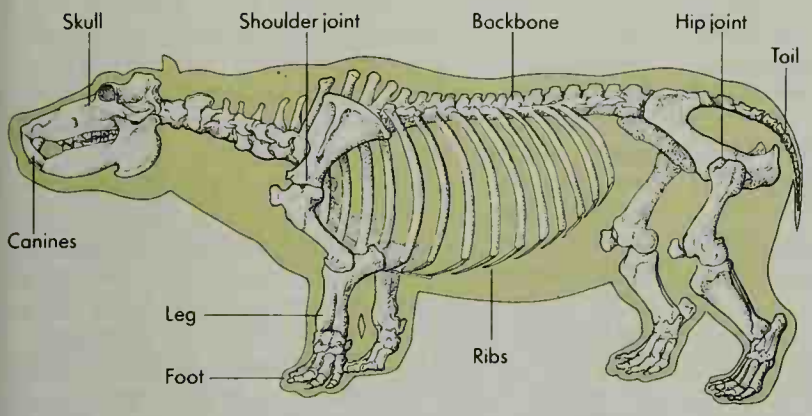
A hippopotamus has long, curved front teeth. Its tusk-like *canines* (side teeth) are even longer. All the teeth grow throughout the animal's life. But they seldom become too long, because the teeth of the upper and lower jaws grind together and wear each other away. The canines of a hippopotamus may grow more than 2 feet (61 centimeters) long, but only about half the tooth sticks out above the gum line.

The life of a river hippopotamus. River hippopotamuses are good swimmers and live in lakes, rivers, and streams near grasslands. They sometimes walk along the bottom of a body of water and can stay underwater for as long as six minutes. On land, they can run as fast

Mark Boulton, National Audubon Society

A river hippopotamus has a stout, barrel-shaped body; short legs; and a huge head. It weighs as much as 5,800 pounds (2,630 kilograms) and ranks as one of the largest land animals. In spite of its clumsy appearance, the river hippopotamus is an excellent swimmer and can run as fast as a human being.

The skeleton of a river hippopotamus



WORLD BOOK illustration by Marion Pahl

Tom Myers

A hippopotamus' tusklike canines can be seen when the animal opens its mouth. Hippopotamuses use their canines for fighting.

as a human being—about 20 miles (32 kilometers) per hour.

River hippopotamuses live in herds of from 5 to 30 animals. They spend the day resting in the water, eating water plants, and sunning themselves on sandbanks. At night, the herd goes on land to feed. The animals eat fruit, grass, leaves, and vegetables. They sometimes wander for miles near the riverbank, grazing as they go. Each hippopotamus eats about 130 pounds (59 kilograms) of vegetable matter a day.

A female hippopotamus carries her young inside her body for about $7\frac{1}{2}$ months before it is born. She almost always has one baby at a time, but sometimes she bears twins. A baby hippopotamus, called a *calf,* weighs about 100 pounds (45 kilograms) at birth. It can swim almost immediately and usually nurses on its mother's milk underwater. It begins to eat grass at the age of 4 to 6 months. A young hippopotamus often climbs on its mother's back and suns itself as she floats on the water. On land, the mother hippopotamus keeps her calf close by. If the youngster wanders away, she butts it as punishment.

A female hippopotamus gives birth to her first baby when she is 5 or 6 years old. Hippopotamuses live about 30 years in their natural surroundings and 50 years in a zoo.

A hippopotamus has an enormous mouth and can open it to a width of 3 to 4 feet (91 to 120 centimeters). The animal frequently does so to show its powerful canines and challenge its enemies. When two hippopotamuses fight, they slash at each other with their canines. Many fights continue until one of the hippopotamuses gets killed or suffers a broken leg. Almost no other kind of animal attacks adult hippopotamuses, but crocodiles, hyenas, and lions sometimes attack the young. If a hippopotamus feels threatened on land, it runs for the water.

The pygmy hippopotamus has a smaller head in proportion to its body than does the river hippopotamus. It weighs from 400 to 600 pounds (180 to 270 kilograms) and stands about $2\frac{1}{2}$ feet (76 centimeters) tall. A pygmy hippopotamus ranges from 5 to 6 feet (1.5 to 1.8 meters) long, not including the tail, which measures 6 to 7 inches (15 to 18 centimeters) long. The animal has blackish skin.

Pygmy hippopotamuses live in thick forests near streams and spend less time in the water than do river hippopotamuses. They live alone or in pairs, rather than in herds. Although the law forbids people from killing pygmy hippopotamuses, Africans shoot many of them for food. As a result, the animal faces the danger of becoming extinct.

Hippopotamuses and people. People have greatly reduced both the number of hippopotamuses and the size of the area in which they live. Hunters have killed large numbers of them, and farmers have made cropland out of many areas where hippopotamuses once made their home. At one time, the animals lived in rivers throughout Africa. Ancient Egyptian paintings show

Where hippos live

The hippopotamus is found in central and southern Africa in rivers, lakes, and marshy ponds. The pygmy hippopotamus lives in Liberia, Sierra Leone, and south Nigeria.

James Annan

A pygmy hippopotamus is much smaller than a river hippopotamus. The animal weighs from 400 to 600 pounds (180 to 270 kilograms). It has a rounded head and oily, blackish skin.

pharaohs hunting them on the Nile River.

African farmers shoot many hippopotamuses to keep the animals from eating or trampling their crops. They also kill hippopotamuses for the meat and use the hides in making soup. The canines of hippopotamuses provide valuable ivory. The ivory was once used for artificial teeth because it did not turn yellow.

Some food experts have urged that hippopotamuses be raised for their meat. The weight of the edible meat of a hippopotamus totals almost two-thirds the weight of the entire body. This proportion is much higher than with most other wild animals. In addition, hippopotamus flesh has an extremely high protein content.

Hippopotamuses have also benefited their environment in certain areas. Their solid wastes provide nourishment for many fish and water plants in the lakes and streams where hippopotamuses live.

Scientific classification. Hippopotamuses make up the hippopotamus family, Hippopotamidae. The river hippopotamus is *Hippopotamus amphibius*. The pygmy hippopotamus is *Choeropsis liberiensis*. James M. Dolan, Jr.

See also **Animal** (picture: Animals of the grasslands).

Hiram. See **Phoenicia** (The spread of Phoenician influence).

Hirohito, *HEER oh HEE toh* (1901-1989), was emperor of Japan from 1926 until his death in 1989. He chose *Showa* as his reign name, and was known as the Showa Emperor.

Before World War II. Hirohito became regent for his father, Yoshihito, in 1921 and he became emperor in December 1926. His reign began during the days of rising democratic sentiment. Universal manhood suffrage had just been introduced, and Japan seemed likely to become increasingly democratic and internationalist. Unfortunately, army circles, particularly those in Manchuria, wanted a stronger foreign policy. Within Japan, criticism of the political parties sharpened after economic crises struck. Military incidents abroad and assassinations in Tokyo soon reversed the democratic and internationalist trends of the 1920's.

Hirohito personally opposed the militarism of the 1930's. But his advisers kept him from making his wishes known, so that the radical militarists would not take direct action against the monarchy. As a result, Hirohito remained silent, and approved the decisions that led to World War II (see **Japan** [World War II]).

After the war. Hirohito took a personal part in the final surrender decision of 1945. His broadcasts to the Japanese people helped bring about the smooth transfer of control of Japan to the United States Army. For a time, it was thought he might have to abdicate or be tried as a war criminal. Although several of the emperor's advisers were tried and convicted of war crimes, Hirohito himself was not.

Keystone

Hirohito

Hirohito did, however, take a new role. On Jan. 1, 1946, he renounced all claims to the divinity that had formerly been claimed for him. The constitution of 1947, which he approved, changed him from sovereign to "symbol of the state," and placed political control in the hands of elected representatives. As a democratic monarch, Hirohito toured the country, visiting scenes of disaster and inspecting Japan's postwar reconstruction. He permitted the imperial family to be photographed, a practice never allowed before. Hirohito chose an American tutor to teach his son, Crown Prince Akihito. In 1959, Akihito broke a centuries-old Japanese tradition by marrying a "commoner," a young woman who did not belong to one of Japan's noble families (see **Akihito**). In 1971, Hirohito became the first Japanese emperor to travel outside Japan during his reign. He toured Europe for 18 days. He visited the United States in 1975. In private life, Hirohito carried on research in marine biology. Kenneth B. Pyle

Hiroshige, *HEER oh SHEE gay* (1797-1858), was a master painter and designer of Japanese color prints. Many critics rank him second in importance only to Hokusai among Japanese artists of the 1800's. His paintings earned him the name of "the artist of the sweeping brush," because of his ability to suggest vast landscapes in a few lines. Bare paper is as important as color in showing great snowfields, the sea, and the sky in his

Color wood block print. Cleveland Museum of Art, gift of J. H. Wade

A Hiroshige color print called *Rain Shower on Ohashi Bridge* illustrates this artist's skill at creating landscapes of the Japanese countryside. Hiroshige was also noted for his ability to integrate small human figures into his realistic compositions.

paintings. Hiroshige's delicate color harmonies and his peculiar perspective influenced the work of the painter James Whistler.

Hiroshige was born in Edo (now Tokyo). His pupils imitated his work and often used his signature. His most famous set of prints is the *Fifty-three Stations of the Tokaido Highway.* Robert A. Rorex

See also Tokyo (picture: *Moonlit Street Scene in Edo*).

Hiroshima, *HEER oh SHEE muh* or *hih ROH shih muh* (pop. 1,126,282), is the Japanese city on which the first atomic bomb used in warfare was dropped. It lies on islands formed by a river delta on the shore of the Inland Sea, in western Honshu (see Japan [political map]).

Hiroshima was originally a fishing village, but it developed dramatically between 1600 and 1868 as a castle town of the Asano family. By the late 1600's, it had become one of Japan's largest cities. It served as a seat of local government, and as a trade center and a port of internal navigation. Its prosperity and population increased in the late 1800's and early 1900's with its industrial growth. By World War II (1939-1945), Hiroshima was an important military center.

During World War II, on Aug. 6, 1945, a United States Army plane dropped a single atomic bomb on the center of the city. Three days later, the Allies dropped a second atomic bomb on the city of Nagasaki. Japan surrendered to the Allied forces on Sept. 2, 1945. The atomic bomb destroyed about 5 square miles (13 square kilometers) of the city. Between 70,000 and 100,000 people are estimated to have been killed by the bomb. Other people died later from the effects of atomic radiation.

Hiroshima was rebuilt after the war. The city has developed major automobile, machinery, and shipbuilding industries, and it has regained its prewar population and importance. The Peace Memorial Park was built where the bomb exploded. A service is held there each year on the anniversary of the bombing, in memory of the victims. The Atomic Bomb Dome, a building that was left unreconstructed after the war, has become a symbol of the peace movement. Kenneth B. Pyle

© Chuck Fishman, Woodfin Camp, Inc.

Hiroshima's Peace Memorial Park honors the victims of the first atomic bomb used in war. The monument, *center,* marks the place where the bomb exploded on Aug. 6, 1945.

See also Nuclear weapon (picture).

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Hirshhorn Museum and Sculpture Garden, in Washington, D.C., houses one of the world's major collections of modern art. The museum has more than 12,000 works by leading international artists from the late 1800's to the 2000's. The Hirshhorn Museum and Sculpture Garden is part of the Smithsonian Institution.

The Hirshhorn Museum is an unusual circular building. Many of the museum's paintings are by American

Draped Reclining Woman (1953), a bronze statue by Henry Moore; Fred M. Dole, FPG

The Hirshhorn Museum and Sculpture Garden features paintings and sculptures by American and European artists.

and European masters, such as Francis Bacon, Willem de Kooning, Anselm Kiefer, and Frank Stella. The sculpture collection includes works by Louise Bourgeois, Alberto Giacometti, Pablo Picasso, Martin Puryear, and Richard Serra. The sculpture garden and plaza alongside the museum feature large-scale works by some of these sculptors and others, including Alexander Calder, Magdalena Jetelova, Auguste Rodin, and David Smith. The Hirshhorn's Henry Moore sculptures make up one of the largest public collections of Moore's work outside of England.

The United States Congress established the museum in 1966 to house the huge art collection that had been donated to the nation by Joseph H. Hirshhorn, an American financier. The Hirshhorn Museum and Sculpture Garden was designed by the firm of Skidmore, Owings & Merrill and opened in 1974.

Critically reviewed by the Hirshhorn Museum and Sculpture Garden

© Randy Taylor, Sygma

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Hispanic Americans represent several different cultures. In these pictures, Mexican-American men play chess in a park; a Puerto Rican shop owner greets a customer; and Cuban-American dancers and musicians perform in a parade.

Hispanic Americans

Hispanic Americans are Americans of Spanish-speaking descent. Many Hispanic Americans are the descendants of Mexican people who lived in the Southwest when it became part of the United States. Almost all other Hispanic Americans or their ancestors migrated to the United States from Latin America. The three largest Hispanic groups in the United States are Mexican Americans, Puerto Ricans, and Cuban Americans. As a group, Hispanic Americans represent a mixture of several ethnic backgrounds, including European, American Indian, and African.

Although the native residents of Puerto Rico are U.S. citizens, Puerto Rico is not a U.S. state. The U.S. Census Bureau therefore does not count the island's native residents as part of the U.S. population. In this article, the term *Hispanic American* applies only to Puerto Ricans who live in a U.S. state.

Today, more than 35 million people of Hispanic descent live in the United States. They make up the largest minority group in the country. African Americans are the second largest U.S. minority group. Hispanics are also the fastest-growing U.S. minority, as a result of a high birth rate and continuing immigration. Asian Americans are the second fastest-growing minority.

Most Hispanic Americans speak English but continue to use Spanish as well. As Spanish-speakers, they form the largest *language minority* in the United States. In addition to their language, Hispanic Americans have preserved many other traditions of their homelands. The foods, music, clothing styles, and architecture of these countries have greatly influenced U.S. culture.

Hispanic Americans are also called *Latinos,* because most are of Latin-American origin. Many Hispanic people in the United States describe themselves simply as Americans. Others, however, identify themselves with their cultural or national background and refer to themselves as Mexican Americans, Puerto Ricans, Cuban Americans, and so on. Members of some groups use special names to describe themselves. For example, some Mexican Americans call themselves *Chicanos,* and some Puerto Ricans who live in New York City refer to themselves as *Nuyoricans* or *Boriquas.*

Like other minorities, Hispanic Americans have suffered from discrimination in jobs, housing, and education. Some Hispanics are also hampered by not having skills that are important for competing in U.S. society. For example, many new Hispanic immigrants cannot speak or understand English. Discrimination and the

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lack of such skills have contributed to a high rate of unemployment—and, consequently, a high rate of poverty—among Hispanics. Although millions of Hispanic Americans have overcome these obstacles, many others remain in poverty.

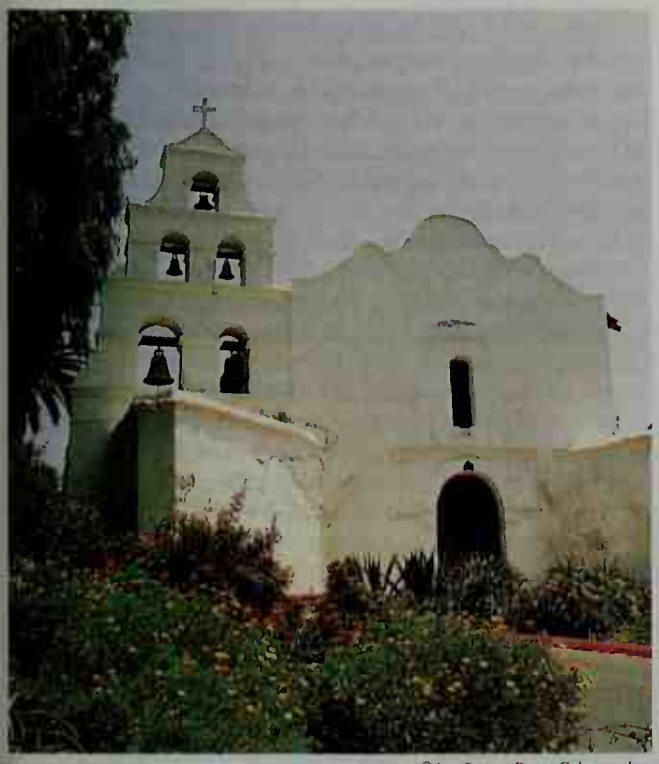
This article focuses on Mexican Americans, Puerto Ricans, and Cuban Americans. It discusses their cultural backgrounds, the history of their immigration to the United States, and the issues that face them today.

Who are the Hispanic Americans?

According to the 2000 U.S. census, the number of Hispanics living in the United States totals more than 35 million. Hispanic Americans represent nearly 13 percent of the total U.S. population. According to the census, nearly 59 percent of all Hispanics in the United States are Mexican Americans. Puerto Ricans make up about 10 percent of the Hispanic population, and Cuban Americans account for about 3 $\frac{1}{2}$ percent. People from Central America, South America, and Spain together make up approximately 9 percent of the Hispanic population. Many Hispanics did not specify a place of origin on their census forms.

The various Hispanic groups in the United States have tended to maintain their separate identities over the years. Since the 1970's, however, efforts to unite Mexican Americans, Puerto Ricans, Cuban Americans, and other groups have gained increasing support. Such efforts often emphasize cultural similarities that date back hundreds of years.

The Spanish language and the Roman Catholic religion are among the oldest and most important cultural bonds that unite Hispanics. During Spain's colonial period, which lasted from the 1500's to the 1800's, Spanish missionaries and landowners spread their language and religion throughout the areas they controlled. As a result, nearly all Hispanic Americans can speak Spanish, and a large majority are Roman Catholics.



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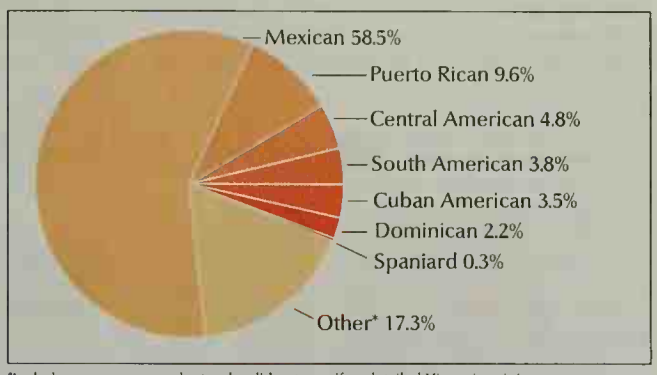
Spanish missions shaped colonial cultures by passing on the Spanish language and Roman Catholicism. San Diego de Alcalá, the first mission in California, was established in 1769.

Ethnic background of Hispanic Americans



*Includes census respondents who did not specify a detailed Hispanic origin. Figures are for 2000. Source: U.S. Census Bureau.

Hispanics in the United States today speak a variety of Spanish dialects, depending on their country or region of origin. But the speakers of one dialect can usually understand the speakers of another with no difficulty. Although some Hispanic Americans do not use Spanish at all, most continue to speak Spanish in their homes and teach the language to their children. Many adult immigrants have difficulty learning English, but their children usually grow up speaking both Spanish and English.

Another unifying element is the recognition of common problems. Those Hispanics who are not fluent in English face obstacles in schooling and employment. Moreover, some white, English-speaking Americans regard all Hispanics as one group—a group whose ancestry and linguistic and social background are different from their own. Such perceptions have led to discrimination in housing and employment that affect all Hispanic American groups and foster unity among them.

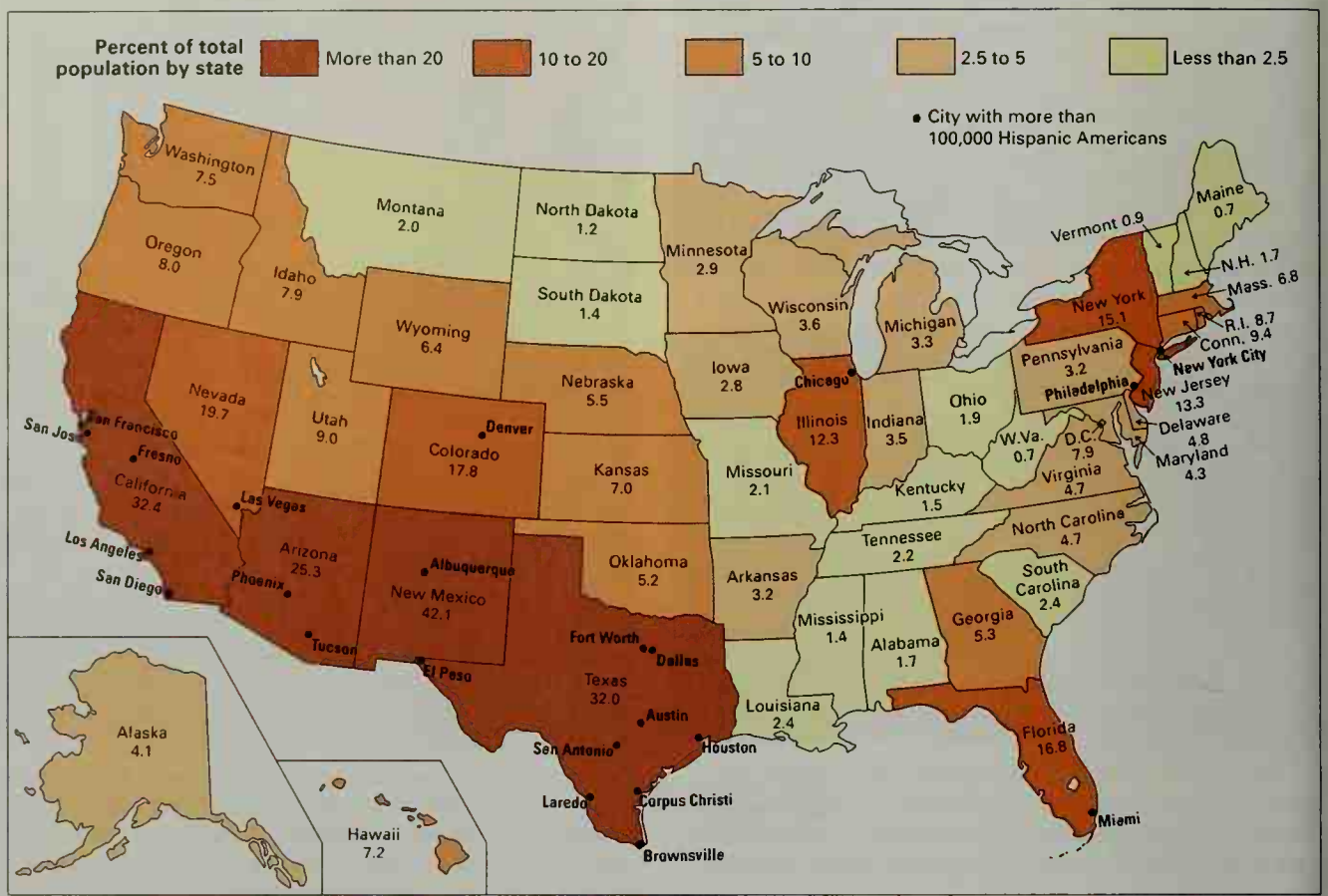
Within the Hispanic American minority, there are people of different national and ethnic origins. Physical appearances vary widely and often show the blending of European, American Indian, and African features that has occurred over many generations. Most Mexican Americans are *mestizos*—that is, they are of white and American Indian ancestry. Their white ancestors were mostly Spaniards who colonized what are now Mexico and the American Southwest. Their Indian ancestors were living in these regions when the Spaniards arrived. Many Puerto Ricans are of mixed Spanish and African descent, with their African ancestors having been brought over by the Spaniards to work as slaves. Other Puerto Ricans have some American Indian ancestry as well. Most Cuban Americans are of Spanish descent, though some blacks and *mulattoes* (people of mixed European and African ancestry) also emigrated from Cuba.

Where Hispanics live

About 90 percent of Hispanic Americans live in urban areas, particularly in Los Angeles, New York City, Miami, San Francisco, Chicago, and many cities in the Southwest. About a third of all Puerto Ricans living on the mainland live in New York City. The New York City area is also home to large groups of Hispanics from Colombia, Cuba, the Dominican Republic, and Ecuador. Chi-

Where Hispanic Americans live

This map shows the state-by-state distribution of the U.S. Hispanic population according to the 2000 census. Numbers on the map indicate the percentage of Hispanics in the total population of each state. The cities on the map have more than 100,000 Hispanic residents.



WORLD BOOK map; source: U.S. Census Bureau.

cago has large Mexican American, Puerto Rican, and Cuban American populations. Colombians and other South American groups have also settled in Chicago. Mexican Americans form the largest Hispanic group in most Southwestern cities, including Los Angeles and San Antonio. Los Angeles also has small Cuban, Guatemalan, and Puerto Rican communities. Miami has the largest Cuban American population of any U.S. city. Large numbers of Nicaraguan immigrants have also settled in Miami and other cities in southern Florida. Some recent Hispanic immigrants have settled in smaller cities, such as Boise, Idaho, and Yakima, Washington.

Cultural backgrounds

In Puerto Rico and Cuba, early Spanish settlers came into close contact with the Arawak Indians. At first, the Spaniards and the Arawak enjoyed friendly relations. But as more Spaniards settled Puerto Rico and Cuba in the early 1500's, they took land from the Arawak and forced the Indians to work for them. The Arawak rebelled against this treatment, but their stone weapons were no match for the Spaniards' guns. Fighting, physical abuse, and disease began to take a heavy toll among the Indians. By the mid-1500's, almost all of the Arawak in Puerto Rico and Cuba had died. See also **Arawak Indians.**

Soon after the first Spanish settlers arrived in the West Indies, they began to import black Africans to replace the rapidly dwindling Indian labor force. Although the hundreds of thousands of enslaved blacks brought to the Spanish colonies far outnumbered the Spaniards, the conditions of slavery limited contact between Spaniards and Africans for many years. The blacks were able to maintain much of their own culture, including religions, folklore, and music. The Spanish colonists, meanwhile, carried on a fairly traditional way of life. Cities in Puerto Rico and Cuba resembled European cities in appearance. Spanish musicians performed the music of Spanish composers in concert halls and churches. The few artists working in the colonies also tended to imitate the European styles of the day.

Eventually, the Spanish and African influences began to blend in Puerto Rico and Cuba. The Spanish influences dominated in language, religion, and architecture. Although many blacks had been baptized as Christians, they combined Christian religious observances with their traditional ceremonies. They also identified some Christian saints with certain African deities.

Other aspects of African culture had a wider influence in Puerto Rico and Cuba. The music and dancing of the Africans became an important contribution to Latin-American culture. Blacks also told traditional African tales that became part of the folklore of the islands.

Probably the most obvious aspect of cultural blend-

© David Frazier Photolibrary

African influences helped create the distinctive sounds of Latin music. Many songs feature African rhythms, played on drums like the timbales, *center of photograph,* and the congas, *right of photograph.* Like the musicians shown at the left, many Latin music groups perform at festivals throughout the United States.

ing in the West Indies was the intermingling of population groups. Many of the Spanish men took African mistresses or wives. Today, most Puerto Ricans have both Spanish and African ancestry. Many Cubans also have mixed ancestry.

In Mexico, the empire of the Aztec Indians covered large areas of central and southern Mexico by the early 1500's. The Aztec capital was Tenochtitlan, one of the most important centers of trade and religion in the Americas. With an estimated population of 200,000 to 300,000, Tenochtitlan was also one of the largest cities in the world at that time. See also **Aztec.**

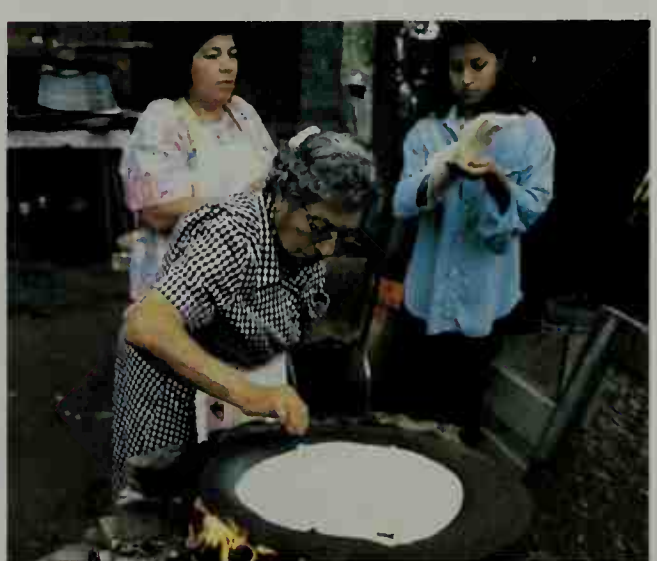
Religion and war were the focal points of Aztec society. Much of the Aztec's art, music, and poetry was intended to glorify their many gods. To remain in favor with their gods, the Aztec practiced human sacrifice. They waged war almost constantly to obtain prisoners to be used as sacrifices.

A complex, highly organized society grew up around the Aztec's religion and military activities. A large government was needed to administer the empire. Laws were strictly enforced by a system of courts, and criminals were often punished harshly for even small crimes. The Aztec encouraged their children to develop a sense of social responsibility from an early age. All children were required to attend school, where they prepared to become priests, warriors, craftsmen, or householders.

Following the Spanish conquest of Mexico in 1521, the Spanish government moved quickly to establish political control of the new territory. It was the Roman Catholic clergy, however, that most effectively introduced Spanish culture among the Indians. Spanish priests and friars started missions where they instructed the Indians in Spanish, Roman Catholicism, and various practical crafts. The missions did not succeed in molding the Indians to live and work in a European society. But they did help start the process of *mestizaje,* the blending of Spanish and Indian cultures.

As in the West Indies, the language and religion of the Spaniards came to dominate. But like the Africans in Cuba and Puerto Rico, the Mexican Indians transformed many Spanish religious ceremonies. For example, Spanish priests used Christmas carols called *villancicos* and solemn pageants called *posadas* to teach the Indians about the events surrounding the birth of Jesus Christ. Over the years, Indian composers wrote many villancicos about nonreligious subjects. The Indians also turned the posadas into festive processions that took place in people's homes rather than in church.

In the arts, the talents of Indian sculptors, craftsmen, and musicians were recognized by the Spaniards. Indian



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Indian influences can be seen in the foods of Mexican Americans. These women are making *tortillas,* thin flour or corn meal pancakes used in many traditional dishes.

wood and stone carvings decorated many buildings that otherwise were of traditional Spanish design. New kinds of music were produced by musicians who combined the sounds of European and Indian instruments.

The Spaniards brought many technological improvements to Mexico. European farming methods and equipment generally brought better harvests than did Indian methods. But in some cases—the cultivation of corn, for example—the Spaniards adopted Indian techniques.

The intermixing of population groups took place in Mexico, as it did in the West Indies. But in Mexico, the intermingling occurred mainly among Spanish men and Indian women. The children of Spanish and Indian parentage became the mestizos, who today are the largest population group among Mexicans and Mexican Americans.

Hispanic influences on American culture

Hispanics in the United States share many of the traditional values claimed by most Americans. They place high value on their families and on success through hard work. They are also proud of their Latin-American heritage. Many Hispanic Americans feel that they should not lose contact with their cultures or their language. Instead, they seek to be bicultural and bilingual. Many hope that their cultures will someday be accepted as being part of American culture.

Although many people consider them a single group, Hispanic Americans represent a rich variety of cultures. A single, common Hispanic culture does not exist. There are, however, important similarities among Hispanic groups, who together strongly influence U.S. culture.

Food is one area in which Hispanic influences are apparent in the United States. Mexican foods are especially popular. The *taco,* a folded tortilla filled with meat, cheese, and other ingredients, is as common in some areas as hamburgers and hot dogs. Other Mexican dishes, such as *enchiladas, tamales,* and *tostadas,* are also served in restaurants throughout the United States.

Entertainment and arts. Since the 1940's, the music and dances of Latin America have also "crossed over" into American culture. Mexican mariachi bands—small ensembles usually consisting of violins, guitars, and trumpets—have long enjoyed popularity in the United States. Dances and dance music from the Caribbean islands, especially Cuba, were first performed in American ballrooms in the late 1800's. Some popular Cuban dances have included the bomba, the cha-cha, the conga, the mambo, the rumba, and salsa. Much of the music and dancing was derived from the culture of African slaves who worked on West Indian sugar plantations from the early 1500's to the 1800's. The music has strong, *syncopated* (irregularly accented) rhythms. It features instruments of African and American Indian origin, including conga drums, claves, güiros, maracas, and marimbas.

Latin-American music has long been an important influence on the popular music of the United States. Since the 1950's, a number of Hispanic-American rock music performers have gained widespread popularity, including Ritchie Valens, Carlos Santana, Gloria Estefan, and the group Los Lobos. Traditional Latin music has also attracted a large audience in the United States. One of the most popular performers of traditional Latin music is Celia Cruz. Known as *la Reina de la Salsa* (the Queen of Salsa), Cruz has performed for more than 40 years in both Cuba and the United States.

A number of painters and writers have sought to capture the Hispanic American experience. Important Hispanic artists include John Valadez, Martin Ramirez, Frank Romero, and Arnaldo Roche. Tomas Rivera, Luis Valdez, and Heberto Padilla rank among the many Hispanic writers who have won distinction. Other major Hispanic American figures in the arts include architect Bernardo Fort-Brescia and fashion designers Adolfo and Oscar de la Renta.

Like other minority groups, Hispanic Americans have often been portrayed as stereotypes on radio and television and in movies and advertisements. Since the 1960's, however, TV shows, movies, and plays that deal more realistically with Hispanic characters have appealed to both Hispanic and non-Hispanic audiences. Hispanic-American actors are now able to play roles that previously would have been reserved for *Anglo* (English-

Chris Gulker

Roosters, a play by Milcha Sanchez-Scott, combines realism and fantasy in its portrayal of the life of a Hispanic farmworker. Like many plays written by Hispanic Americans, *Roosters* deals with problems that confront the Hispanic community.

© John Running, After Image

Cinco de Mayo (May 5) is a national holiday in Mexico. Many Mexican Americans, like these dancers, take part in colorful Cinco de Mayo festivals, especially in the Southwest.

speaking) actors. Successful Hispanic American actors and actresses have included José Ferrer, Raul Julia, Jennifer Lopez, Rita Moreno, and Anthony Quinn.

Sports. Many Hispanics share in the American enthusiasm for sports, and a number of Hispanic athletes have become professional sports stars. Well-known Hispanic American athletes include baseball greats Roberto Clemente, Alex Rodriguez, and Sammy Sosa; golfers Nancy Lopez and Lee Trevino; and jockeys Angel Cordero and Jorge Velasquez.

Holidays. Many Hispanic Americans observe the major holidays of their homelands in addition to U.S. holidays. Mexican Americans celebrate the anniversary of Mexico's independence from Spain on September 16. Cinco de Mayo, which commemorates Mexico's victory over an invading French army on May 5, 1862, is also a day of celebration among Mexican Americans. Puerto

© Herbert Eisenberg, Shostal

The annual Puerto Rican Day parade in New York City features music and dancing as well as performers in traditional costumes of Puerto Rico and the countries of Latin America.

© Joe Viesti

Las posadas (the inns), a Mexican Christmas festival, is celebrated in San Antonio, *shown here,* and other U.S. cities with large Mexican American populations. Each night from December 16 through Christmas Eve, people take part in processions that represent Mary and Joseph's search for lodgings in Bethlehem on the first Christmas Eve. The people carry candles or lanterns and sing special posada songs.

Ricans observe Constitution Day on July 25, the date on which Puerto Rico's constitution became effective in 1952. Cuban Americans celebrate Cuban Independence Day on May 20, the date Cuba gained its independence from Spain in 1898.

The United States observes National Hispanic Heritage Month each year from September 15 to October 15, when many Latin-American countries celebrate their independence. Besides Mexico, these countries include Costa Rica, El Salvador, Guatemala, Honduras, and Nicaragua. Some cities with large Hispanic communities hold annual festivals featuring the arts and crafts, food, and music and dancing of Latin America. These festivals include Miami's nine-day Calle Ocho, held in March of each year, and the Fiesta de la Primavera, held in San Diego in May. Other Hispanic festivals are held at Christmas and Easter and on other religious holidays. One of the largest of these festivals is the nine-day Mexican Christmas festival of *las posadas,* which features songs and processions commemorating Mary and Joseph's search for an inn in Bethlehem.

The history of Hispanic-American immigration

Exploration and settlement. The Hispanic presence in what is now the United States actually began before the country existed. Spanish explorers established colonies in what would become the Southeast and Southwest regions of the United States.

In the Southeast. In 1513, the explorer Juan Ponce de León sailed from Puerto Rico to the east coast of Florida. He claimed the peninsula, which he thought was an island, for Spain, thus becoming one of the first explorers to stake a Spanish claim in North America.

In 1526, a colonizing force under the leadership of Lucas Vásquez de Ayllón, a Spanish nobleman, founded the first European settlement in the present-day United States. Historians believe that this settlement, named San Miguel de Gualdape, stood somewhere along the coast of what is now Georgia and South Carolina. Before the end of the year, malaria and other diseases killed about two-thirds of the original population of 600, including Ayllón. The remaining settlers returned to the West Indies in early 1527.

The Spaniards did not establish a permanent settlement in the Southeast until 1565. In that year, the Spanish explorer Pedro Menéndez de Avilés founded St. Augustine in Florida. This was the first permanent European settlement in what would become the United States. It predated Jamestown—the first permanent British settlement in North America—by more than 40 years. St. Augustine served as Spain's military headquarters in North America during the 1500's.

Florida remained under Spanish control until 1763, at which time Spain was forced to give the territory to Britain. Spain regained Florida in 1783, but problems soon broke out between the Spanish colony and the new United States. American settlers moved into Florida, and the U.S. government sought to purchase the territory from Spain. In 1821, Florida came under United States control, and thousands of Americans poured into the territory. Soon the Spanish presence in Florida was overwhelmed by the tide of English-speaking settlers.

In the Southwest. To the west, the desire for wealth and fame led the Spaniards to expand their claims in Mexico. In 1540, the explorer Francisco Vásquez de Coronado set out to conquer the legendary Seven Cities of Cibola, which were said to lie north of Mexico. Coronado and his men explored areas of present-day New Mexico, Arizona, Texas, Oklahoma, and Kansas in the hope of finding the great riches they had heard described. The expedition returned to Mexico in 1542. No gold had been found, but Coronado had claimed a vast area of the North American continent for Spain. The area was given the name New Mexico. See also **Cibola, Seven Cities of; Coronado, Francisco Vásquez de.**

In 1598, the first Spanish settlers arrived in New Mexico to begin missionary work among the Pueblo Indians. The settlers established Santa Fe, the capital of New Mexico, in 1609 or 1610. The Spaniards treated the Indians harshly, and in 1680 the Pueblos revolted. The Indians killed about 400 Spaniards and captured Santa Fe. The Spaniards did not retake Santa Fe until 1692.

University of South Florida Archives

St. Augustine was the first permanent European settlement in the United States. It was founded in 1565 to secure Spanish claims in Florida. This engraving shows the town and its fortress, *top,* under attack by British forces encamped on Anastasia Island, *center.* The engraving dates from 1740, 23 years before the British gained control of Florida. The region became a U.S. territory in 1821.

Culver

The Mexican War resulted from disputes between Mexico and the United States over control of Mexico's northern territories. In one of the final battles of the war, attacking American troops defeated a much larger Mexican force at Churubusco, near Mexico City, on Aug. 20, 1847. On Sept. 14, 1847, Mexico surrendered. During the peace negotiations following the war, the United States acquired the vast territories that now include California, Nevada, Utah, and parts of four other states.

The Spanish settlement of Texas began in 1682, when two missions were built by Franciscan friars. By 1731, the Spaniards had established missions throughout central, east, and southwest Texas. But Spanish colonization of Texas proceeded slowly. By 1793, the territory had only about 7,000 white settlers.

California also was part of the Spanish Empire in the New World. First settled by the Spaniards in 1769, California remained sparsely populated for many years. By the 1820's, Franciscan friars had established 21 missions in California. The Spanish governors had also built a number of *presidios* (forts) in California.

During the early 1800's, the westward expansion of the United States alarmed the Spanish colonial governors. These officials restricted trade between the United States and the northern colonial provinces of New Mexico, Texas, and California. By so doing, they hoped to avoid a heavy flow of American settlers into the sparsely populated colonies.

In 1821, Mexico gained its independence from Spain. The new nation included the northern provinces, as well as present-day Mexico. Soon, free trade with the United States was established in New Mexico. The government of the Republic of Mexico tried to regulate U.S. trade in New Mexico, which led to increasing resistance among the New Mexicans, many of whom did not feel especially loyal to Mexico.

Mexicans living in California, called *Californios,* also opened free trade with the United States and other countries. The Mexican government broke up the missions and gave or sold huge tracts of ranch lands to private individuals. As a result, a small group of several hundred Mexican landowners became very wealthy. But most Californios, like the majority of settlers throughout Mexico's northern territories, remained poor.

The abundant resources of California attracted many American settlers in the 1830's and 1840's. The United States was already considering ways of acquiring California as a territory. The Californios enjoyed the benefits of their trade with the United States and saw advantages to becoming a U.S. territory. The Mexican government neglected its northern territories, and many Californios resented the interference of government officials from Mexico City.

Texas had by far the smallest population of any of the northern Mexican territories, and the Mexican government's hold on Texas was weak. In January 1821, American merchant Moses Austin received permission from Spanish authorities in Mexico to settle 300 Americans in Texas. The project eventually passed into the hands of Austin's son, Stephen Fuller Austin. Instead of being limited to 300 settlers, however, the American settlement of Texas swelled to thousands of people. In 1836, Texas won its independence from Mexico and became a republic. See Texas (History).

Conflict. In 1845, the United States annexed Texas. In response, the Mexican government broke off relations with the United States. Texas claimed territory as far south as the Rio Grande, but Mexico disputed the claim, saying that Texas' southwest border was the Nueces River. These and other events led to the Mexican War (1846-1848) between the United States and Mexico. The United States won the war. The Treaty of Guadalupe Hidalgo, which ended the war, awarded the United States the territory that now makes up the states of California, Nevada, Utah, most of New Mexico and Arizona, and part of Colorado and Wyoming. This vast area was home to approximately 80,000 Mexicans, most of whom were granted U.S. citizenship. See also Mexican War.

The original draft of the Treaty of Guadalupe Hidalgo stated that the United States would honor any land grants that had been made by the government of Mexico. However, this provision was deleted in the U.S. government's revision of the treaty. Mexican officials protested this change. At the signing of the treaty, the U.S. representatives also signed the Protocol of Querétaro, which stated that the U.S. government's changes in the original treaty did not invalidate the civil, political, and

religious guarantees that the treaty had extended to Mexican residents of the new U.S. territories. The U.S. government, however, did not ratify the Protocol of Querétaro, claiming that its representatives at the treaty signing did not have the authority to sign the protocol. Mexico's government also failed to ratify the protocol.

Many of the new Hispanic Americans were living on land that had been granted to them by the Mexican government. For many years after the war, Mexican-American landowners in the Southwest were able to maintain their claims. But as more and more Anglo settlers came in search of land on which to raise crops and livestock, the demand for land soared. Mexican-American landowners had to legally confirm their claims. The process was so lengthy and expensive that many were forced to take out large loans to pay court costs. They often sold large tracts of their land in order to pay off their loans. Many Mexican Americans were unable to communicate with the English-speaking judges and did not understand the U.S. court system. As a result, they were often cheated out of their legitimate claims to the land.

By the late 1800's, most Mexican Americans had become tenants or workers on land that belonged to Anglo-Americans. The two groups lived apart in towns and cities, and each had its own schools, stores, and places of entertainment. The Mexican Americans called their sections *barrios,* the Spanish word for *neighborhoods.*

During this period, the immigration of Mexicans to the United States was relatively small. Jobs on large cattle, sheep, cotton, and vegetable farms attracted some Mexicans to Texas. But the great period of Mexican-American immigration was yet to come.

The early 1900's. In 1900, the total Mexican-American population was estimated to be between 380,000 and 560,000. The early 1900's saw a sharp increase in the number of Mexican immigrants as economic conditions in Mexico worsened. In 1910, the Mexican Revolution broke out. This conflict plummeted Mexico into years of political and economic chaos. The revolution also sparked a tremendous wave of immigration that continued until the 1930's.

Between 1910 and 1930, more than 680,000 Mexicans came to live in the United States. During the 1920's, Mexicans accounted for more than 10 per cent of all immigration to the United States. Most Mexicans fleeing the Mexican Revolution settled in the Southwest, where they took jobs in factories and mines or on railroads, farms, and ranches.

In 1917, the United States entered World War I (1914-1918), and thousands of Mexican Americans volunteered for service in the U.S. armed forces. The wartime economy also provided new opportunities for Mexican Americans. Some were able to move into better-paying, skilled occupations in construction and in the war industries.

Despite these gains, Mexican Americans continued to suffer discrimination in jobs, wages, and housing. To fight these conditions, they organized labor unions and took part in strikes to obtain higher wages and better working conditions. Mexican Americans also formed civic groups to deal with their problems. In 1929, the major groups merged to form the League of United Latin American Citizens (LULAC).

Immigration restrictions and growing discrimination. In 1917, the United States passed a law requiring all adult immigrants to be able to read and write at least one language. In 1924, the U.S. Bureau of Immigration established the Border Patrol to control illegal immigration across the Mexican-U.S. border. Strict enforcement of the 1917 adult literacy law led to a decline in Mexican immigration in the late 1920's. This decline continued through the Great Depression—the economic hard times of the 1930's—when only about 33,000 Mexicans entered the United States.

The 1930's brought heightened discrimination against Mexican Americans. Many people viewed them as a drain on the American economy because they held many low-paying jobs while other, "true" Americans went unemployed. In response to such angry views, the U.S. and Mexican governments cosponsored a *repatriation program* that returned thousands of Mexican immigrants to Mexico.

The program was intended to encourage people to return voluntarily to Mexico, but thousands were deported against their wishes. Many of these immigrants had lived in the United States for more than 10 years. Their American-born children were U.S. citizens. In some cases, adults who were deported were U.S. citizens who were mistakenly or intentionally forced to leave their country. In California especially, many Mexican Americans were placed in detention camps, where they were mistreated by government officials. Of the approximately 3 million people of Mexican descent living in the United States in 1930, about 500,000 had been repatriated by 1939. The repatriation program created much anger and resentment among Mexican Americans. Family relationships were often strained because young people who had been born in the United States did not want to go to Mexico.

In addition to the humiliation of repatriation, Mexican Americans suffered other forms of discrimination. Many restaurants refused to serve Mexican Americans. Public swimming pools, rest rooms, drinking fountains, and theaters were often segregated. Mexican-American schoolchildren were often forbidden to speak Spanish in schools and were sometimes punished severely for doing so.

Effects of World War II. During World War II (1939-1945), more than 300,000 Mexican Americans served in the U.S. armed forces. Their courage and determination helped them earn proportionally more military honors than any other ethnic group. Many Mexican-American veterans returned from the war with new-found skills. Unwilling to go back to living with the pressures and barriers of discrimination, they formed a number of social, political, and service organizations, including the Mexican American Political Association (MAPA) and the American GI Forum of the United States. Such organizations have helped Mexican Americans fight poverty, lack of education, and discrimination.

World War II had renewed the demand for immigrant labor. In 1942, the U.S. and Mexican governments developed the bracero program. Under the program, Mexican *braceros* (day laborers) could enter the United States legally for seasonal agricultural work and for work on U.S. railroads. Bracero programs were in effect from 1942 to 1947 and from 1951 to 1964. The programs

provided almost 5 million Mexicans with temporary work in the United States. The braceros often worked under harsh conditions for unsympathetic employers, but they took the work because they were unable to find jobs in Mexico.

Growing numbers of newcomers. The mid-1900's saw a great influx of Hispanic people into the United States. These new arrivals included not only Mexicans, but large numbers of Puerto Ricans and Cubans, too.

Mexican immigration to the United States—both legal and illegal—climbed steeply during the 1950's. The U.S. government developed a program to curb illegal immigration. The program was highly publicized in order to encourage undocumented immigrants to leave voluntarily. It resulted in the deportation of a total of 3,800,000 undocumented immigrants. It did little, however, to control illegal immigration, which continued to increase from the 1960's through the 1980's.

Puerto Rican migration. The mid-1900's also brought the first great wave of people from Puerto Rico. This island had been a U.S. possession since 1898, and its people had been U.S. citizens since 1917. As citizens, Puerto Ricans may enter the United States without restriction. Between 1940 and 1960, more than 545,000 Puerto Ricans came to the U.S. mainland to look for jobs. By 1960, almost 70 percent of Puerto Ricans living on the mainland had settled in East Harlem in New York City. New York City has continued to have the largest Puerto Rican population of any mainland U.S. city, with about a third of all Puerto Ricans on the mainland living in the city.

For many years, Puerto Ricans have remained one of the poorest groups in the United States. Unemployment among Puerto Ricans is about 50 percent higher than it is among the general population, and the poverty rate is almost four times higher.

Cuban immigration to the United States picked up sharply during the late 1950's, as a result of increasing political turmoil in Cuba. Until the mid-1950's, only a few thousand Cubans came to the United States each year. But during the late 1950's and early 1960's, the number of Cuban immigrants increased dramatically. In 1959, Cuban revolutionary Fidel Castro came to power. He announced the restructuring of Cuban society. Many middle- and upper-class Cubans found Castro's plans threatening to their way of life. Between 1959 and late 1962, about 200,000 anti-Castro Cubans immigrated to the United States.

Photoworld from FPG

Hundreds of thousands of Puerto Ricans, such as this family, came to the U.S. mainland between 1940 and 1960 to find jobs.

In October 1962, commercial air flights between Cuba and the United States were suspended. Nonetheless, about 50,000 Cubans entered the United States between late 1962 and 1965. Many of these people sailed secretly from Cuba in small boats, some of which were apprehended by the Cuban navy before they reached the United States. In 1965, the United States and Cuban governments agreed to set up an airlift between Cuba and Miami. The airlift brought about 250,000 Cubans into the

UPI Bettmann Newsphotos

Many Cubans fled to the United States following the 1959 take-over of the Cuban government by Fidel Castro. This anxious Cuban family is shown on arrival in Miami in August 1963—hours after they had escaped capture by a Cuban navy patrol in the Bahamas.

United States between 1966 and 1973.

Until 1986, the United States admitted most Cuban immigrants who claimed to be seeking political asylum. Many of the first Cubans to flee in the early 1960's were from wealthy families and were well educated. The U.S. government granted asylum to these people and offered federal help to qualified applicants in finding homes and in making job contacts. Most later Cuban immigrants were relatives of the first group or were poor people looking for work.

A major influx of Cuban immigrants was the arrival in 1980 of the *Marielitos*. Numbering about 125,000, the Marielitos were a group that the Cuban government wanted out of Cuba. They included many unskilled workers, criminals, and mentally ill people. These people were put aboard boats at the Cuban port of Mariel and sent to Miami. The U.S. government allowed the Marielitos to enter the United States.

But U.S. officials had not expected that there would be such large numbers of Marielitos. In addition, officials were at first unaware of the presence of criminals on board the boats. Some of the criminals were placed in U.S. prisons. Many of them were rehabilitated and released. A few were returned to Cuba.

In 1986, U.S. President Ronald Reagan announced that only long-term political prisoners in Cuba and close relatives of Cuban Americans would be allowed to enter the United States. He also stated that U.S. visas would no longer be granted to Cubans seeking to enter the United States from other countries. However, the government later softened its policy.

In 1994, thousands of Cubans set out for Florida on small boats and rafts to escape poverty in Cuba. United States immigration officials sent the refugees to U.S. military bases in Panama and at Guantánamo Bay on Cuba's coast. Most of the refugees were eventually admitted to the United States. But to avoid the costs of settling large numbers of additional people, the U.S. returned many later refugees to Cuba. Despite efforts to return Cuban refugees to their homeland, the United States admits thousands of them each year.

A major controversy erupted in late 1999 and early 2000 over custody of 6-year-old Cuban shipwreck survivor Elián González. In November 1999, a group of Cubans that had included Elián and his mother attempted to emigrate from Cuba to the United States on a small boat. The boat capsized, and Elián's mother and nearly all the other passengers drowned. Two fishermen from the United States rescued Elián. The boy was hospitalized briefly and then taken to the home of his great-uncle Lázaro González in Miami, Florida. Shortly afterward, Elián's father, Juan Miguel, demanded that the boy be returned to him in Cuba. Lázaro, however, applied for political asylum in the United States for Elián.

In January 2000, the United States Immigration and Naturalization Service (INS) ruled that Elián should be returned to his father in Cuba. Lázaro, however, disputed the ruling through a series of legal proceedings. The idea of returning Elián to Cuba met with widespread opposition in the Cuban American community, and many people gathered outside Lázaro's house to demonstrate their support for him.

In April, Elián's father arrived in the United States to take the boy back to Cuba. Meanwhile, Lázaro and the other Miami relatives rejected repeated proposals by representatives of the U.S. Justice Department to arrange a meeting with Juan Miguel and a reunion of Elián with his father. Finally, on April 22, armed federal agents enforced a government order that the boy be returned to his father. The agents seized Elián and flew him to be reunited with his father, who was staying near Washington, D.C. Juan Miguel and Elián returned to Cuba on June 28.

Nearly two-thirds of all Cuban Americans live in Florida. More Cuban Americans live in Miami than in any other city in the United States. Large numbers of Cubans also live in suburban towns outside Miami and in Tampa, which is on Florida's west coast. Although the Little Havana section of Miami remains the center of the Cuban American population, many Cubans have now moved into the city's wealthier neighborhoods. Some of Miami's most successful businesses are owned and operated by Cuban Americans. New York City, Los Angeles, and Chicago also have significant populations of Cuban Americans.

Cuban Americans face many of the same problems as other minority groups, though to a lesser degree. Cuban Americans generally attain a higher level of education than other Hispanic Americans. The unemployment and poverty rates of Cuban Americans are also lower than those of other Hispanic groups.

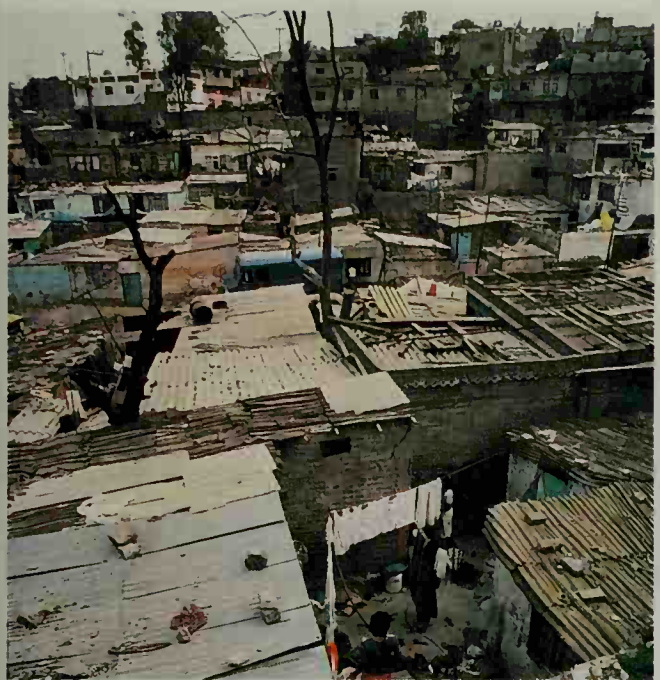
Central American migration. Beginning in the 1970's, large numbers of Hispanic immigrants came to the United States from war-torn countries in Central America, including El Salvador and Nicaragua. Many of these immigrants were children and teen-agers whose parents had been killed or had disappeared. Some United States citizens believed that Central Americans fleeing military conflict should be granted political asylum in the United States.

The United States government, however, maintained that most of these immigrants had been motivated by economic, not political, concerns. Therefore, the government argued, the immigrants were not entitled to the special treatment given political refugees under United States immigration law. The U.S. government placed many of the Central American immigrants in large detention camps until they could be relocated or returned to their homelands.

Stricter immigration laws. During the 1980's, Congress struggled to find a way to stop the flow of thousands of people who enter the country illegally each year. After years of study and debate, Congress finally passed the Immigration Reform and Control Act of 1986, which took effect in 1987.

The new law offered legal status to undocumented immigrants who had lived continuously in the United States since before Jan. 1, 1982. The law enabled 3.1 million previously illegal immigrants—most of them Hispanics—to obtain legal status. It also allowed temporary agricultural workers to enter the United States during harvest season.

In addition, the new law imposed penalties on employers who knowingly hired undocumented immigrants. But many employers found the law difficult to understand and even harder to apply. Some critics also charged that the law encouraged relatives of legal immigrants to enter the country illegally.



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Extreme poverty in some areas of Mexico, including these slums outside Mexico City, has led many Mexicans to continue to seek employment opportunities in the United States.

Immigration rates among Hispanic groups in the United States varied widely during the late 1900's. Emigration from Mexico increased steadily from the 1950's to the 1990's. Mexicans continued to form the largest group of legal immigrants to the United States. Thousands of people from Mexico also entered the United States illegally each year.

The migration from Puerto Rico reached its height in the 1940's and 1950's. However, many Puerto Ricans still came each year to look for jobs or to settle near relatives.

Cuban immigration was highest from the 1960's to the mid-1980's, when it began to drop dramatically. The decline resulted in part from the stricter immigration policies adopted under presidents Ronald Reagan and Bill Clinton.

Hispanic Americans in the late 1900's

Hispanics were among the fastest-growing U.S. minority groups during the late 1900's. But their political influence increased at a much slower pace, and their educational and economic opportunities also lagged.

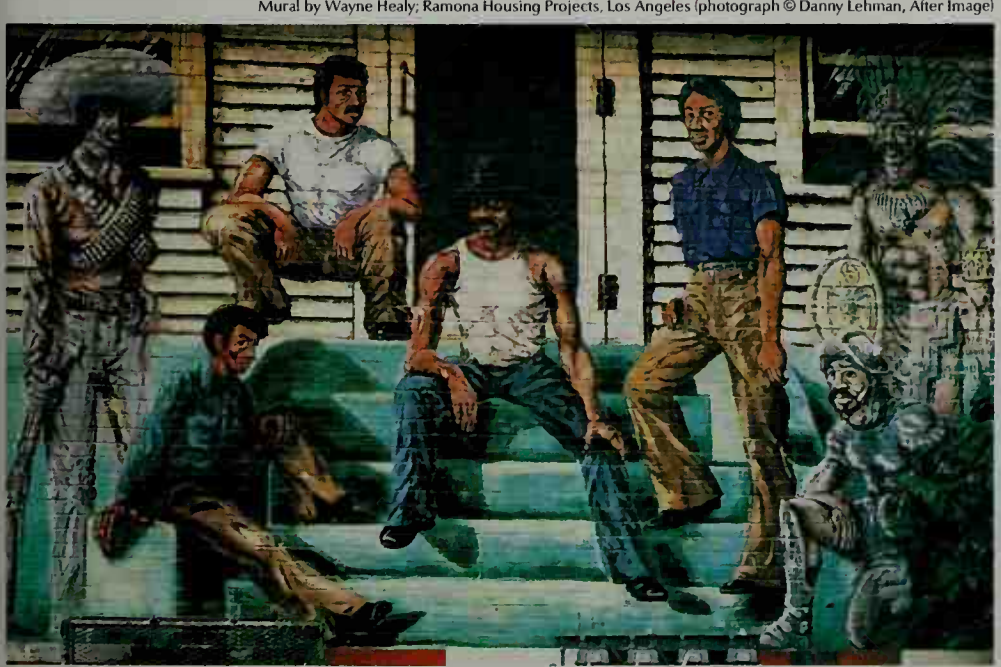
Political developments. Until the 1960's, discrimination at the polls discouraged many Hispanics from registering to vote. Some states required the payment of a *poll tax* before a person was allowed to vote. The tax was intended to keep Hispanics, African Americans, and other minorities—many of whom were too poor to afford the tax—from voting. In areas with large Hispanic populations, voting district boundaries were often drawn to scatter the Hispanic voters over several districts. This practice, called *gerrymandering,* held down the percentage of Hispanic voters within any one district.

Expanding influence. During the 1960's, four Mexican Americans won election to Congress and became champions of civil rights. They were Senator Joseph Montoya of New Mexico, Representatives Eligio de la Garza and Henry B. Gonzalez of Texas, and Edward R. Roybal of California. In 1965, Congress enacted the Voting Rights Act, which outlawed the poll tax.

President Lyndon B. Johnson appointed several Hispanic Americans to high government posts in the 1960's. For example, Johnson made Hector P. García a member of the U.S. delegation to the United Nations and appointed Raul H. Castro U.S. ambassador to El Salvador.

The Chicano movement. In spite of the success of a growing number of Hispanic Americans, many others became more resentful about their problems. Among Mexican Americans in particular, such feelings found expression in the Chicano movement, also called the "brown power" movement, founded in the 1960's. Although the origin of the word *Chicano* is uncertain, some Mexican Americans have considered the term a negative label for their ethnic group. But by founding

Mural by Wayne Healy; Ramona Housing Projects, Los Angeles (photograph © Danny Lehman, After Image)



Ghosts of the Barrio, a mural on a building in East Los Angeles, honors the heritage of Mexican Americans by including historical figures in a modern scene. An Indian warrior and a Spanish conquistador appear in the right of the mural, and a Mexican revolutionary stands at the left. Murals that celebrate Hispanic-American ethnic pride, cultural history, and individual achievement are common in East Los Angeles.

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Labor leader Cesar Chavez worked to improve the lot of his fellow Mexican Americans. He is shown here receiving Communion after ending a hunger strike in the summer of 1988. Chavez had gone on the hunger strike to protest the use of suspected cancer-causing pesticides by California table grape growers. The chemicals posed a potential danger to migrant farmworkers—most of whom are Mexican Americans.

the Chicano movement, young Mexican Americans gave the term a meaning that suggested ethnic pride.

One of the foremost Hispanic Americans to reflect that new ethnic pride was Cesar Chavez, a labor leader who began to organize California grape pickers in 1962. In 1963, Reies López Tijerina founded the Alianza Federal de Mercedes (Federal Alliance of Land Grants) in New Mexico. That group fought to win compensation for descendants of families whose lands had been seized illegally. Another leader was Rodolfo Gonzales, who founded the Crusade for Justice in Denver in 1965. That group worked to provide social services and develop job opportunities for Mexican Americans. In 1970, José Angel Gutiérrez helped establish La Raza Unida, a political party based in Texas.

Political gains. In the 1980's and 1990's, many more Hispanic Americans got involved in the political process. Voter registration drives added hundreds of thousands of Hispanics to the rolls. Political activists legally challenged gerrymandering. The federal courts agreed that voting district boundaries were purposely drawn to split up Hispanic communities. The courts ordered that the district lines be redrawn to better represent established communities. With new boundaries in place, more candidates supported by Hispanics were elected to office.

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Increased voter participation among Hispanic Americans has helped them make important political gains. This man is casting his ballot in an election in California.

In 1980, there were 6 Hispanic Americans serving in the U.S. Congress. By the early 2000's, that number had increased to 21. In addition, hundreds of Hispanic Americans were elected as state officials, mayors, county and municipal officials, and school board members. These officials included Miami Mayor Maurice Ferre, of Puerto Rican descent, the first Hispanic mayor of a large U.S. city; mayor of San Antonio Henry G. Cisneros, the first Mexican American mayor of a major U.S. city; Xavier Suarez, Miami's first Cuban-born mayor; Mayor Federico F. Peña of Denver; and Governor Bob Martinez of Florida. Despite these gains, Hispanics held only about 1 percent of U.S. elective offices in the early 2000's.

In 1988, Lauro Cavazos became the first Hispanic U.S Cabinet member when President Reagan appointed him secretary of education. Other presidential appointments since the 1980's have included Katherine Ortega, U.S. treasurer under Reagan; Manuel Lujan, Jr., interior secretary under President George H. W. Bush; Henry G. Cisneros, secretary of housing and urban development under President Bill Clinton; Federico F. Peña, secretary of transportation and of energy under Clinton; Bill Richardson, ambassador to the United Nations and secretary of energy under Clinton; and Melquiades R. Martinez, secretary of housing and urban development under President George W. Bush. In 1990, Antonia C. Novello became the nation's first Hispanic surgeon general.

Education. For many years, the educational achievements of most Hispanic American students had lagged behind those of non-Hispanic students. During the 1980's, Hispanic Americans made slight gains. In 1980, only 44 percent of Hispanic Americans age 25 and older were high school graduates. The 1990 U.S. census showed that 53 percent of Hispanic Americans age 25 and older graduated from high school. Despite this modest increase, the dropout rate remained almost double the dropout rate of non-Hispanic students.

One of the earliest programs designed to improve public education for Hispanic students was bilingual ed-

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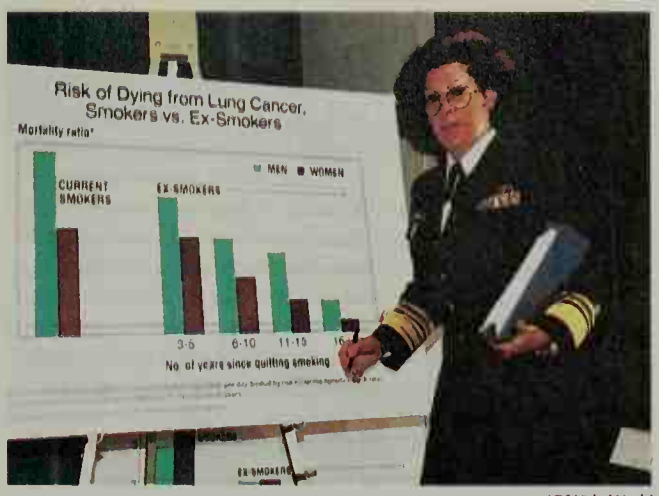
Lauro Cavazos, at the left, became secretary of education—and the first Hispanic Cabinet member—in 1988.



AP/Wide World

Antonia C. Novello, *shown here,* became the first Hispanic surgeon general of the United States in 1990.

ucation. In 1968, the U.S. government began to fund bilingual programs for students who do not speak English as their first language. In early bilingual programs serving Hispanics, students were taught in Spanish in such basic subjects as mathematics and science. Meanwhile, they studied English as a second language. When they were ready, they transferred to classes taught only in English. By the 1990's, many schools had replaced that transitional approach to bilingual education with *two-way bilingual education,* which combined native Spanish speakers with English-speaking students in all classes. The students progressed together through the grade levels, with some subjects taught in Spanish and others in English. The participants helped one another learn both the new language and the subjects being taught.

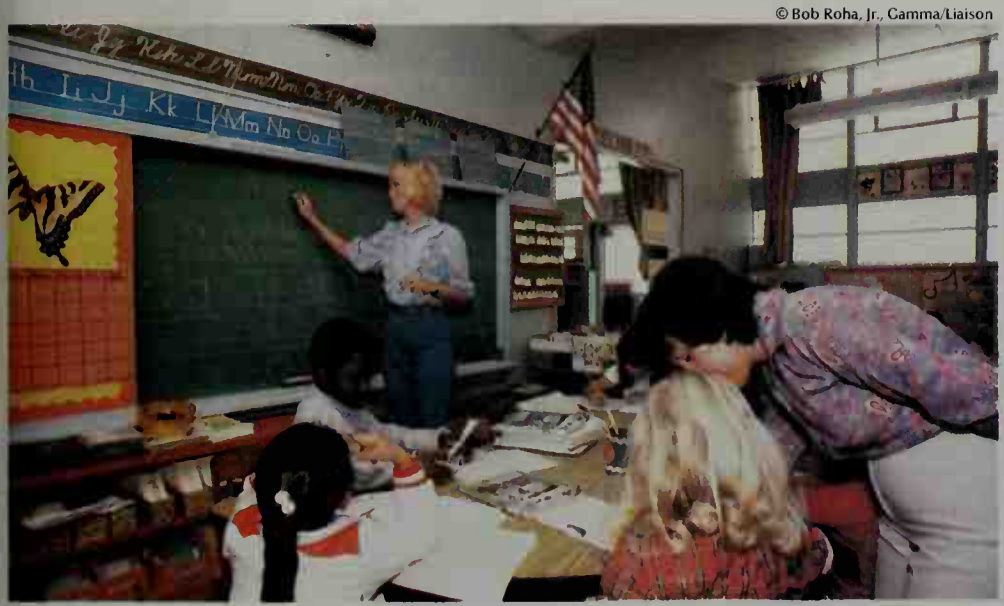
Since bilingual education began, it was controversial. Critics claimed that bilingual programs encouraged students to rely too much on Spanish. Supporters argued that bilingual education never received enough support. They claimed that lack of funding and of teacher-training programs hindered such education. In 1998, California voters approved a controversial measure requiring that all public school classes be taught only in English. But bilingual classes remained available in California to students whose parents or school boards requested them and to students with special needs.

Employment. Low education levels, poor English skills, discrimination, and the continued immigration of unskilled workers contributed to high unemployment among Hispanic Americans. During the late 1900's, the unemployment rate among Hispanics was nearly twice as high as among non-Hispanic whites. The median income of Hispanics was also consistently low. In the 1990's, about 30 percent of Hispanic families lived in poverty, while about 11 percent of non-Hispanic white families were impoverished.

Though Hispanics experienced many economic problems, the number of Hispanic-owned businesses rose substantially. By the early 1990's, Hispanic-owned companies represented about 5 percent of all U.S. firms.

Hispanic Americans today

People from Latin America continue to immigrate in large numbers to the United States. Hispanics historical-



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Bilingual education programs are designed to help students who speak little or no English keep up in other subjects while they learn the language. In the bilingual class at the left, Hispanic students are taught math and science in Spanish, and they study English as a second language. When the students can readily speak and understand English, they transfer to all English-speaking classes.

ly have accounted for more than a third of all legal immigration to the United States. For many, the United States represents opportunities unavailable in their homelands. Most want to work hard and to improve the lives of their families. But for many Hispanic families, slow educational progress hinders efforts to achieve a better life.

A rapidly growing minority. A high rate of immigration and a high birth rate have combined to make Hispanic Americans one of the fastest-growing minority groups in the United States. From 1990 to 2000, the Hispanic population increased nearly 60 percent—more than four times faster than the nation's total population. The 2000 census reported that Hispanics had become the nation's largest minority group.

Some non-Hispanics in the United States fear that the country's rapidly growing Hispanic population will not adopt the language, customs, and viewpoint of the dominant, English-speaking culture. Some of these people fear that their way of life will be replaced by the "foreign ways" of Hispanic Americans. Others worry that a large Spanish-speaking minority will become a permanent underclass, locked out of economic advancement by a lack of fluency in English. Many historians and sociologists discount such fears. They point to the many immigrant groups that have become part of American culture. They also note that except for recent immigrants, most Hispanic Americans can speak English.

Nevertheless, language is an increasingly controversial issue in some states with large Spanish-speaking populations. About 25 states have passed laws making English their official language. Some people support passage of a constitutional amendment that would make English the official language of the United States.

An increased demand among Hispanic Americans for Spanish-language media has led to the development of two national Spanish-language television networks. In addition, hundreds of U.S. radio stations broadcast in Spanish. Also, many Hispanic newspapers, magazines, and journals are published in the United States.

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Signs in Spanish and English are common in areas with large Hispanic American populations. Bilingual public signs and documents have become controversial in some places, and several states have passed laws making English their official language.

Concerns about education. The number of Hispanic Americans who have completed college has risen slightly since 1980. However, only about 10 percent of Hispanic Americans are college graduates, compared with more than 25 percent of non-Hispanic white Americans. With more and more jobs requiring a college degree, Hispanic business and education leaders are concerned about high dropout rates and low college attendance among Hispanic young people.

Discrimination continues to plague many Hispanic American students. Studies have shown that Hispanic students have often been assigned to classes for low achievers, forced to repeat grades, or classified as mentally handicapped because they do not speak English well or because of other cultural differences.

Hispanic leaders support the hiring of more Hispanic teachers for Spanish-speaking students. Such teachers tend to be more sensitive to the linguistic and cultural background of Hispanic students. Leaders also call for improvements in English-language courses and counseling services for Hispanic students. Some schools have developed dropout prevention programs, career guidance programs, and multicultural education programs aimed at providing better educational opportunities for Hispanic students.

Many educators believe that more funding for school loans and more flexible college admissions requirements are needed to increase the number of Hispanics in college. College scholarships are offered by several Hispanic American organizations, including the American GI Forum of the United States, the League of United Latin American Citizens, the Mexican American Legal Defense and Education Fund, and the National Council of La Raza.

Homer D. C. García

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Outline

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II. **Where Hispanics live**
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  B. In Mexico
IV. **Hispanic influences on American culture**
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  B. Entertainment and arts
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V. **The history of Hispanic-American immigration**
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  C. The early 1900's
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VI. **Hispanic Americans in the late 1900's**
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  C. Employment
VII. **Hispanic Americans today**
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  B. Concerns about education

Questions

What are the three largest Hispanic groups in the United States?
What happened to the land grants of Mexican American landowners following the end of the Mexican War?
What factors have contributed to high unemployment among Hispanic Americans?
What is the Immigration Reform and Control Act of 1986?
What are some Hispanic influences on American culture?
Why did many middle- and upper-class Cubans flee their homeland in the early 1960's?
Hispanic Americans from which country make up the largest group of legal immigrants to the United States?
What were the effects of the repatriation program of the 1930's?
When was the period of heaviest Puerto Rican migration to the mainland United States?

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Level II

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Hispaniola, *HIHS puhn YOH luh,* is the second largest island in the West Indies. It lies between Cuba and Puerto Rico in the Caribbean Sea. For location, see **West Indies** (map). The Republic of Haiti occupies the western third of Hispaniola, and the Dominican Republic covers the eastern two-thirds of the island. The island is about 400 miles (640 kilometers) long and 150 miles (240 kilometers) wide. It has an area of about 29,500 square miles (76,500 square kilometers). Christopher Columbus arrived at Hispaniola in 1492 and called it *La Isla Española* (the Spanish Island). Later it was called Santo Domingo.

Hispaniola has a population of about 13 million. More than half the people are farmers. The chief crops are coffee, *cacao* (chocolate seeds), and sugar cane. Other important economic activities are food processing, manufacturing, mining, and tourism. Gerald R. Showalter

See also **Dominican Republic; Haiti.**

Hiss, Alger (1904-1996), became the center of a national controversy over Communist infiltration in the United States government under President Harry S. Truman in the 1940's and 1950's. A number of Republican congressmen, including Representative Richard M. Nixon, had charged the government with employing Communists who acted as secret agents for the Soviet Union.

The controversy reached a climax in 1948. Whittaker Chambers, a confessed former Communist spy, accused Hiss, a former high official in the U.S. Department of State, of having given him secret government documents in the 1930's. Hiss denied the charge but resigned from his position as head of the Carnegie Endowment for International Peace. Chambers produced microfilms of confidential government papers that he had hidden in a pumpkin on his farm in Maryland. He said Hiss had given him the secrets to send to the Soviet Union.

Hiss was brought to trial in 1949. He was charged with perjury for denying accusations that he gave away secret documents and for claiming that he had not seen Chambers since Jan. 1, 1937. By law, Hiss could not be

Wide World

Hiss and his accuser, Whittaker Chambers, were brought face to face during a session of the House Un-American Activities Committee in 1948. Hiss, *standing, left,* was convicted of perjury largely on evidence supplied to the government by Chambers, *standing, far right.*

charged for spying because too much time had passed. Important government officials, including two associate justices of the Supreme Court of the United States, testified for Hiss. However, the jury could not agree on a verdict.

Hiss was brought to trial on the same perjury charges late in 1949. The government introduced new evidence in an attempt to prove that Hiss's personal typewriter had been used to copy 42 confidential government documents. On Jan. 21, 1950, the jury found him guilty. Hiss was sentenced to five years in prison. He was paroled after serving 3 years and 8 months, and he continued to declare his innocence.

Hiss was born on Nov. 11, 1904, in Baltimore. He graduated from Johns Hopkins University and Harvard Law School. He served in the Department of State from 1935 to 1947. He participated in the Dumbarton Oaks Conference and the Yalta Conference. He served as secretary-general of the United Nations founding convention.

Thomas C. Reeves

See also **Chambers, Whittaker; McCarthy, Joseph R.; Nixon, Richard M.; Un-American Activities Committee.**

Additional resources

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Histology, *hihs TAHL uh jee,* is the biological science that studies the structure of the tissues of organisms. In the early 1600's, scientists began using simple microscopes to observe the structural features of various plants and animals. Histology developed as a science in the mid-1800's, when the use of compound microscopes made it possible to view features of cellular and subcellular tissues. Today, the electron microscope enables histologists to examine details of tissues magnified by hundreds of thousands of times. By using various chemical techniques, histologists can identify the precise location of various proteins, lipids, and carbohydrates in tissues. Charlotte H. Greene

Related articles in *World Book* include:
Bichat, Marie F. X.
Botany
Cell
Malpighi, Marcello
Microscope
Tissue

Histoplasmosis, *HIHS tuh plaz MOH sihs,* is a disease that attacks the lungs, mouth, throat, ears, bone marrow, spleen, liver, and lymphatic system. It is caused by a fungus called *Histoplasma capsulatum.* The infection begins in the lungs and is usually not dangerous. Most people suffer only mild cases with flulike symptoms or no symptoms at all. But infants and patients with AIDS may develop severe cases. Histoplasmosis can be fatal if it spreads to other parts of the body. It is not contagious.

Histoplasmosis occurs throughout the world. It is most common in the Ohio and Mississippi river valleys of the United States. *H. capsulatum* grows well in moist soil and produces *spores* (seedlike structures). Infection results when these spores are inhaled. Histoplasmosis is treated with the drug amphotericin B. John R. Graybill

See also **Bird** (In nature).

Historical Association, American, is an organization of about 15,000 historians, educators, and others interested in history. It aids teachers through conferences and publications. The association publishes the *American Historical Review* five times a year. The American Historical Association was chartered in 1889. Its headquarters are in Washington, D.C.

Critically reviewed by the American Historical Association

History is a branch of knowledge concerned with the study of past events. Historians study records of events and prepare new accounts based on their research. These written accounts attempt to explain the causes and effects of events and offer interpretations of them.

The study and writing of history make the past meaningful by preserving structure, values, and continuity for present society. This article discusses history as a field of investigation and knowledge. For information on events in history, see **World, History of the,** and the *History* sections of the various articles on continents, countries, states, and provinces.

History is more than memory and different from myth. Unlike memory, history is constructed from evidence. Unlike myth, history is subject to critical examination and correction. Historians are committed to telling a verifiable account of the past and offering rational explanations for the course of events. Historians are required to offer evidence in support of assertions, create balanced and well-informed accounts, and make an honest, good-faith attempt to overcome personal bias.

How historians work

The questions. A work of history begins with questions about the past. For example, how were societies formed, governed, or destroyed? How did law, religion, education, and art develop, and how did they influence life? How did people create wealth, and how was it distributed? The historian's questions direct and focus research, act as a guide to selection of evidence, and help test the evidence for its meaning.

The questions that historians ask always reflect the concerns of the times in which they live. For example, an interest in the popularity of violent entertainment in today's society might lead a historian to study why the ancient Romans found gladiatorial combat exciting. As a result, history is never "finished." There is never a final, complete version that satisfies everyone. There will always be new questions to ask of the past, and historians will always incorporate these questions in the process of creating written history.

The evidence. Historians use evidence in a great variety of forms, distinguishing broadly between *primary sources* and *secondary sources.* Primary sources are those that originate from the same period of time the historian is investigating. Secondary sources are works of history written about an earlier time. A well-trained historian studies the work of other historians—that is, secondary sources—to learn basic information and the state of current knowledge. But an original interpretation that advances knowledge depends on the examination of primary sources.

Most primary sources are written documents. They include the official records of government institutions, churches, schools and universities, clubs and associations, industries, and trade groups. Among these records are court proceedings and other legal records; executive orders, diplomatic correspondence, and proceedings of legislatures; military records; taxation and

treasury records; and birth, death, and marriage certificates. Copies of private letters and diaries, household accounts, and family documents are also important.

Published writings on all branches of learning—including philosophy, theology, medicine, social criticism, and contemporary news reports—make a central part of the historical record. Literature, music, and visual arts, including advertising, photography, and motion pictures, are also valuable sources for the historian.

The interpretation. The quality of historical research depends on the skills the historian has in deciphering and interpreting documents and objects. Historians read documents in their original languages, and routinely master skills from other disciplines, ranging from art history and archaeology to statistics and economics. They also may extract statistical information from original records and translate it into a form that computers can read and analyze.

Historians must be aware of *bias* (prejudice), both in the evidence and in themselves. The cruder forms of bias, such as stereotyping and hostility toward particular groups, are fairly easy to detect. But historians also try to recognize the deep assumptions that the people who produced documents and other historical sources may have made about what events were significant, who was important enough to notice, and which aspects of life were worth recording. Historians must likewise be aware of such assumptions in themselves and in fellow historians. Whole groups of people and their lives, accomplishments, point of view, and voices can be effectively "erased" from history if historians do not see them as historically significant.

The writing. Historical knowledge requires specialized forms of writing that combine narrative and interpretation and follow modern standards for accuracy and verification. A narrative is a storylike description of events unfolding over the course of time. Historical narratives include depictions of characters, concrete details, descriptions of actions, and explanations of the causes and effects of events, and they indicate the evidence for all these things. In historical writing, unlike fiction writing, the writer has an implied commitment to depict events that are verifiably true and based on reliable information.

Approaches to history

Different questions, different answers. Historians approach their work with various research questions and strategies, and different interpretive theories. Traditionally, historians focused mainly on strategic decisions by political and military leaders. They ignored most of the population as well as impersonal forces and causes of change. In the 1900's, however, historians turned their attention to subjects that were largely or completely left out of historical writing in the past. These subjects include economic history, social history, women's history, gender history, and the history of minorities.

Economic history analyzes the large-scale, long-term developments of entire economies. It places great importance on the economic self-interest of individuals and classes of people. In studying imperialism, labor, and industrial practices, economic analysis has proved especially adapted to tracing the history of social inequalities.

Social history includes the study of large groups of the population, usually those who have little economic or political power. Social historians examine a variety of topics, including grass-roots political movements; voting patterns; migration between rural, urban, and suburban ways of life; immigration; and social attitudes.

The feminist movement that began in the late 1960's and the 1970's inspired a growing number of scholars to study women's history. Women's history had been largely ignored by most historians before then, but the field quickly grew in range and depth, covering all areas of history from ancient to modern society.

Women's history led to the historical study of *gender*. Gender includes the behavior, manners, morals, speech, and emotions expected of men and women because of their sex. Historians of gender have analyzed many characteristics of "masculine" and "feminine" behavior in relation to social stereotypes and economic power. The historians' studies have provided a means to understand a wide range of social behavior—from attitudes about sex to economic inequality—in terms of social conventions of gender.

People who share a common culture, ethnicity, or religion have increasingly become the focus of historical research. Such research does not aim to submerge the group into a common national identity but to respect the point of view and experience of the group itself. The history of African Americans, in particular, has produced a rich range of studies. People who have been ignored because of their homosexuality are being restored to the historical record.

Development of historical writing and study

The ancient Greeks and Romans. The first major works of history in the Western tradition were written by Herodotus and Thucydides, who lived in ancient Greece in the 400's B.C. Herodotus is often called the "Father of History." In his *Histories,* he tried to trace the hostility between the Persian Empire and Greece back to its earliest sources. Before writing the work, Herodotus traveled throughout the Near East. He observed local religions and cultures, spoke with priests and intellectuals, and collected traditions and historical anecdotes. The resulting history of the Persian invasion of Greece ranges widely over time and place. It includes the customs, traditions, myths, and conflicting beliefs that Herodotus recorded in his effort to understand the causes of great political and military events.

Thucydides used his own experience as an Athenian general to create his *History of the Peloponnesian War.* This history of the war between Athens and Sparta focuses on politics and strategy and is narrower but deeper than Herodotus's work. Thucydides rejected conflicting traditional stories in favor of a combination of eyewitness evidence and reliable second-hand accounts. The works of Herodotus and Thucydides established what became the major, traditional subject matter of history—politics and war. They became the models for the special features of historical writing: detailed narrative based on evidence rather than invention, and analysis that distinguished between immediate and long-term causes.

The Romans learned historical writing from Greek models. An important history of Rome was written in the

100's B.C. by a Greek named Polybius, who attempted to explain the rise of Roman political and military dominance to the Greek-speaking world.

The general and statesman Julius Caesar celebrated his own victories in Gaul (France) in a clear, direct style of Latin in his *Commentaries on the Gallic War,* written in the 50's B.C. In the 40's B.C., Gaius Sallustius Crispus, commonly called Sallust, analyzed the corruption and disintegration of the Roman Republic in *Conspiracy of Catiline* and *War Against Jugurtha.* His brilliant, vigorous style attracted and influenced other writers for centuries afterwards. Livy based his history, called *From the Founding of the City,* on the national traditions and historical accounts of Roman military and political actions from the origins of Rome to the early imperial period. *The Histories* and *Annals* of Cornelius Tacitus examine Roman history from the death of the emperor Augustus in A.D. 14 through the reign of Domitian, which ended in A.D. 96. Tacitus's intellect and elegant style had great impact on the writing of history. In general, Roman historical writing valued literary skill and upheld the values of the traditional governing classes.

The Bible and post-Roman history. Beginning in the A.D. 300's, Christianity became the dominant religion of the Roman Empire, and over the next several centuries, it became the main religion in much of Europe. As a result, the influence of the Bible came to touch every aspect of culture. Both the Jewish Hebrew Bible (called the Old Testament by Christians) and the Christian New Testament offered religious revelation in historical form, through narratives of human lives and events. The biblical narratives also suggested that ordinary people could be worthy of historical memory because of their spiritual courage or holiness. Christian historians attempted to find divine intentions and religious meaning in contemporary history and included spiritual as well as political events in their works. Medieval histories tend to lack the literary polish of the Roman period, but they often have greater realism and vitality, and a wider range of characters and subjects, than classical works have.

The histories produced in the new kingdoms that emerged in Europe during the Middle Ages combined spiritual with *secular* (nonreligious) content. These histories also expressed the emerging national identities of Europe. Important works from the earlier Middle Ages include *History of the Franks* (written in the A.D. 570's to 590's) by Gregory, bishop of Tours; *Ecclesiastical History of the English People* (completed in 731) by Bede, an English monk; *Life of Charlemagne* (written about 829 to 836) by Einhard; and *Life of King Alfred* (about 893) by Asser, a Welsh monk. Among the many accomplished historians of the 1000's to 1300's are the Norman monk Ordericus Vitalis, the German bishop Otto of Freising, the English monk William of Newburgh, John of Salisbury, Matthew Paris; and the French priest Jean Froissart.

The Humanist movement, which began in Italy in the 1300's, inspired a renewed study of the Greek and Roman classics, in both their style and form. Humanist scholars regarded themselves as the true heirs of Greek and Roman culture and considered their time a Renaissance (rebirth) of ancient standards. Histories written under this influence focused on secular concerns, especially politics, war, and diplomacy. Humanist Italian historians include Niccolò Machiavelli, the author of the political study *The Prince* (written in 1513, first printed in 1532), and Francesco Guicciardini, the author of *History of Italy* (completed in 1540, published 1561-1564). Humanist scholars divided Western history into three periods, which have become known as (1) Antiquity (ancient times); (2) the Middle Ages, which they considered a period of few accomplishments; and (3) the Renaissance, their own time. This division has had a lasting impact on how historians view the past, though they now recognize the creativity and vitality of medieval culture.

Antiquarian research and the philosophes. A form of scholarship known as *antiquarianism* spread across Europe beginning in the 1500's. Antiquarian scholars gathered, preserved, recorded, edited, and cataloged the basic materials for history. In England, for example, the antiquarians William Camden and Sir Robert Cotton collected early records and other historical materials, including many that had been scattered after monasteries were closed during the English Reformation. Other leading antiquarians included Jean Mabillon in France and a Jesuit religious order, the Bollandists, in Flanders (now part of Belgium). Without the research of the antiquarians, the primary sources for many fields of history throughout Europe might have been lost.

During the Age of Reason, which lasted from the late 1600's to the late 1700's, a group of French intellectuals called the *philosophes* became prominent. The philosophes found antiquarian scholarship dry and too detailed. They preferred to write broad historical narratives to illustrate large-scale theories of the progress and decline of civilization. In general, the works of the philosophes reflected the respect for rationality, critical thought, secular values, and scholarship that characterized the Age of Reason. Leading philosophes included the Marquis de Condorcet, Montesquieu, and Voltaire.

At the same time the philosophes were active in France, the British historian Edward Gibbon wrote his *History of the Decline and Fall of the Roman Empire.* This masterpiece of historical writing was published in six volumes between 1776 and 1788. Gibbon combined the strict scholarship of the antiquarians with the thoughtful interpretation and elegant style of the philosophes.

History in the universities. During the 1800's, history began to be taught as an independent intellectual discipline in universities. Previously, historians had trained for the clergy, law, diplomacy, or politics. They were self-taught in history. The emphasis in the 1800's on the nation-state and its history and identity, however, changed attitudes toward history. The study and writing of history gained public importance, attracted more students, and finally achieved the recognition of a university subject. Increasingly, historians became trained professionals. Students of history had to master difficult research methods and standards for accuracy and verification of facts before their work gained respect.

The German historian Leopold von Ranke had a major impact on the development of history in the 1800's. His influence helped make *archival research*—that is, the analysis and evaluation of primary documents—a central part of historical training. German universities introduced the use of seminars for training future historians in methods of research.

The French historians François Guizot and Jules Michelet based their national histories on archival research performed within professional academic settings. By the middle to late 1800's, "modern"— that is, post-Roman—history was established at Oxford University by William Stubbs and other English scholars. In the United States, universities adopted the German-style research seminar as the basis of graduate training in history, beginning in the late 1800's. Also during the 1800's, historians in France, Germany, Ireland, and the United Kingdom edited and published massive national collections of historical documents.

History today. Developments in the historical discipline during, and since, the 1900's have paralleled the political, social, cultural, and economic changes of the age. In the 1800's, nearly all university-trained historians were male, white, and middle or upper class. Their historical perspectives reflected their world, which seemed stable and clear to many of them. Today, historians are more diverse, as are the subjects they study. Historians now research a wide variety of subjects that their forerunners ignored. These subjects include women; farmers; industrial workers; ethnic, sexual, and religious minorities; political dissenters; and private and domestic life. Nancy F. Partner

Related articles in *World Book.* See World, History of the, and the *History* section of the various articles on continents, countries, states, and provinces. See also the following articles:

American historians

Adams, Brooks
Adams, Henry B.
Bancroft, George
Barzun, Jacques
Beard, Charles and Mary
Breasted, James H.
Catton, Bruce
Commager, Henry Steele
De Voto, Bernard
Dodd, William E.
Du Bois, W. E. B.
Durant, Will
Fiske, John
Franklin, John Hope
Freeman, Douglas Southall
Galarza, Ernesto
Morison, Samuel Eliot
Nevins, Allan
Parkman, Francis
Quarles, Benjamin A.
Schlesinger, Arthur M., Jr.
Sparks, Jared
Tuchman, Barbara W.
Turner, Frederick Jackson
Woodson, Carter G.

British historians

Acton, Lord
Bede, Saint
Bryce, James
Carlyle, Thomas
Churchill, Sir Winston
Clarendon, Earl of
Geoffrey of Monmouth
Gibbon, Edward
Macaulay, Thomas B.
Maitland, Frederic W.
Toynbee, Arnold J.
Trevelyan, George M.

French historians

Condorcet, Marquis de
Froissart, Jean
Montesquieu
Taine, Hippolyte A.
Thiers, Louis Adolphe
Tocqueville, Alexis de
Voltaire

Other historians

Burpee, Lawrence J.
Caesar, Julius
Herder, Johann G. von
Herodotus
Huizinga, Johan
Ibn Khaldun
Josephus, Flavius
Livy
Machiavelli, Niccolò
Plutarch
Ranke, Leopold von
Spengler, Oswald
Suetonius
Tacitus, Cornelius
Thucydides
Xenophon

Other related articles

See the following with their *Related articles:*

Ancient civilization
Archaeology
Byzantine Empire
Canada, History of
Culture
Egypt, Ancient
Exploration
Greece, Ancient
Indian, American
Industrial Revolution
Middle Ages
Mongol Empire
Persia, Ancient
Prehistoric people
Renaissance
Rome, Ancient
United Nations
United States, History of the
War

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Hitchcock, Alfred (1899-1980), was an English motion-picture director and producer. He won fame for his thrillers, first in England, and later in the United States.

Hitchcock's English films, made during the 1920's and 1930's, were fast-paced, straightforward melodramas. They featured exciting chases, rather than plot and character development. *The Pleasure Garden* (1925) was Hitchcock's first film.

Hitchcock gained his first successes with *The Lodger* (1926), based on the Jack the Ripper murders; and *Blackmail* (1929), the first British feature film with sound. Hitchcock got the attention of Hollywood after making the skillful suspense films *The Man Who Knew Too Much* (1934, remade in 1956), *The Thirty-Nine Steps* (1935), and *The Lady Vanishes* (1938).

Hitchcock moved to the United States in 1939 and became a U.S. citizen in 1955. In contrast to his English movies, Hitchcock's American films probed more deeply into the psychology of the characters and were longer, more complex works. *Rebecca* (1940), Hitchcock's first U.S. film, won the Academy Award as best picture. His other major American films include *Shadow of a Doubt* (1943), *Spellbound* (1945), *Strangers on a Train* (1951), *North by Northwest* (1959), *Psycho* (1960), and *Frenzy* (1972). Hitchcock never won an Academy Award as best director, but he did receive the Academy's life achievement award in 1967.

From 1955 to 1962, Hitchcock produced and hosted the 30-minute television series "Alfred Hitchcock Presents." He continued to produce and host the series from 1962 to 1965 when it became "The Alfred Hitchcock Hour." Alfred Joseph Hitchcock was born on Aug. 13, 1899, in London. Queen Elizabeth II knighted him in 1980, and he became known as Sir Alfred Hitchcock.

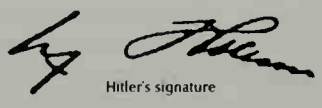
Gene D. Phillips

Hitches. See Knots, hitches, and splices.

Pictorial Parade

Adolf Hitler was dictator of Germany from 1933 to 1945.

Adolf Hitler



Hitler's signature

Hitler, Adolf (1889-1945), ruled Germany as dictator from 1933 to 1945. He turned Germany into a powerful war machine and provoked World War II in 1939. Hitler's forces conquered most of Europe before they were defeated in 1945.

Hitler spread death as no person has done in modern history. "Have no pity! Act brutally!" he told his soldiers. He ordered tens of thousands of those who opposed him to be executed, and hundreds of thousands to be thrown into prison.

Hitler particularly persecuted Jews. He ordered them removed and killed in countries he controlled. Hitler set up concentration camps where about 4 million Jews were murdered. Altogether, Hitler's forces killed about 6 million European Jews as well as about 5 million other people that Hitler regarded as racially inferior or politically dangerous.

Adolf Hitler began his rise to political power in 1919, the year after World War I had ended. The German Empire had been defeated, and the nation's economy lay in ruins. Hitler joined a small group of men who became known as *Nazis*. He soon became their leader. Hitler and his followers believed he could win back Germany's past glory. He promised to rebuild Germany into a mighty empire that would last a thousand years.

Many people did not take Hitler seriously. But his fiery words and brilliant blue eyes seemed to hypnotize those who listened to him. Many Germans believed he was their protector and friend. His emotional speeches made crowds cheer "Heil, Hitler!" ("Hail, Hitler!").

Hitler became dictator of Germany in 1933 and quickly succeeded in regaining some territories taken from Germany as a result of World War I. He threatened war against Czechoslovakia in 1938 but was stopped by a combination of counterthreats and concessions. His forces invaded Poland in 1939. Then Britain, France, Australia, New Zealand, South Africa, and Canada declared war on Germany, and World War II began.

Hitler had a clear vision of what he wanted, and he had the daring to pursue it. But his aims had no limits, and he overestimated the resources and abilities of Germany. Hitler had little regard for experts in any field. He regularly ignored the advice of his generals and followed his own judgment, even while Germany was being defeated in the last years of the war. Finally, as United States, British, and Soviet troops closed in on the

Peter Hoffmann, the contributor of this article, is William Kingsford Professor of History at McGill University.

heart of Germany, Hitler killed himself.

For a detailed discussion of conditions in Germany during Hitler's time, see **Germany** (History).

Early life

Boyhood. Adolf Hitler was born on April 20, 1889, in Braunau, Austria, a small town across the Inn River from Germany. He was the fourth child of the third marriage of Alois Hitler, a customs official. Alois Hitler was 51 years old when Adolf was born. Adolf's mother, Klara Pölzl, was 28 years old. She was a farmer's daughter.

Alois Hitler was born to an unmarried woman named Anna Maria Schicklgruber. A wandering miller named Johann Georg Hiedler married her about five years later. Hiedler died in 1856, when Alois was 20 years old, having never recognized Alois as his child. In 1876, Hiedler's brother arranged for Alois to be registered as the legitimate son of Johann Georg and Maria Hiedler. The priest who made the entry spelled the name "Hitler." Years later, before he came to power, some of Hitler's political opponents called him Schicklgruber as an insult. Only four of Alois Hitler's eight children lived to adulthood. Adolf had a sister, Paula; a half brother, Alois; and a half sister, Angela.

About six years after Adolf's birth, his father retired and moved near Linz, Austria. Adolf received good marks in elementary school, but he was a poor student in high school. His low marks angered his harsh, ill-tempered father. Alois wanted his son to have a career as a civil servant. But the boy wanted to be an artist.

Alois Hitler died in 1903, and Adolf left high school 2½ years later at the age of 16. His mother drew a widow's pension and owned some property. Adolf did not have to go to work. He spent his time daydreaming, drawing pictures, and reading books.

Years in Vienna. In 1907, Hitler went to Vienna, the capital of Austria-Hungary. He wanted to be an art student, but he failed the entrance examination of the Academy of Fine Arts twice. His mother died in 1907. Adolf had an income from the money his mother left her children and inherited some money from his aunt. He also claimed an orphan's pension. Sometimes he sold his drawings and paintings. He lived comfortably and idly during most of his stay in Vienna, considering himself an artist.

Hitler also concerned himself with political observations, admiring the effective leadership and organization of the Social Democratic Party in Vienna. He developed a growing hatred for Jews and Slavs. Like many German-speaking Austrians, Hitler became fiercely nationalistic. No form of government could last, he thought, if it treated people of different nationalities equally.

Corporal Hitler. In 1913, Hitler moved to Munich, Germany. The Austrian Army called him for a physical examination, but he was found unfit for service.

World War I began in August 1914. Hitler volunteered immediately for service in the German Army and was accepted. He served valiantly as a messenger on the Western Front for most of the war, taking part in some of the bloodiest battles. He was wounded and twice decorated for bravery. But Hitler rose only to the rank of corporal. When Germany surrendered in November 1918, he was in a military hospital recovering from temporary blindness that resulted from his exposure in battle to mustard gas. He was deeply shaken by news of the armistice. He believed that the unity of the German nation was threatened, and that he must attempt to save Germany.

Rise to power

Defeat in World War I shocked the German people. Despair and turmoil increased as the army returned to a bankrupt country. Millions of Germans could not find work. A socialist-liberal republic replaced the defeated empire (see **Germany** [The Weimar Republic]).

After World War I, Germany was forced to sign the Treaty of Versailles. The treaty held Germany responsible for the war. It stripped the nation of much territory and restricted the German Army to 100,000 men. It also provided for a 15-year foreign occupation of an area of western Germany called the Rhineland. But the harshest part was the demand that Germany pay huge *reparations* (payments for war damages). The sums demanded

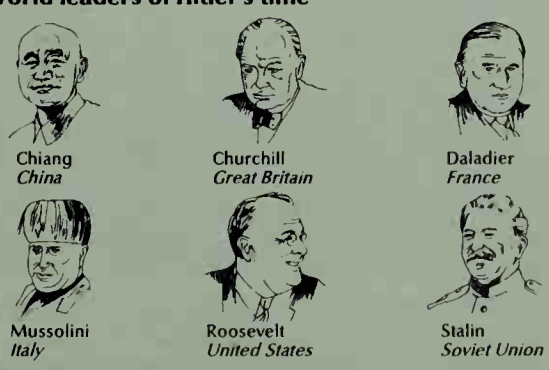
Folco, Sygma

Hitler's birthplace was an inn in Braunau, Austria, near the German border. As a boy, Hitler wanted to be an artist.

Important dates in Hitler's life

1889 (April 20) Born in Braunau, Austria.
1914-1918 Fought in the German Army in World War I.
1923 Led the Beer Hall Putsch.
1924 Began to write *Mein Kampf* while imprisoned for treason.
1933 Named chancellor of Germany; began rearming Germany.
1936 Sent his troops into the Rhineland.
1939 Began World War II by invading Poland.
1945 Committed suicide in Berlin.

World leaders of Hitler's time



by the treaty were so great that they made peace difficult. Nationalists, Communists, and others attacked the new government. The nationalists demanded punishment for the "criminals" who had signed the treaty.

Birth of the Nazi Party. After Hitler recovered from the mustard gas, he returned to Munich and remained in the army until March 1920. In the autumn of 1919, he began to attend meetings of a small nationalist group called the German Workers' Party. He joined the party and changed its name to the National Socialist German Workers' Party. The group became known as the Nazi Party. The Nazis called for the union into one nation of all Germans, including the Austrians and German minorities in Czechoslovakia and other countries. They demanded that citizens of non-German or Jewish origin be deprived of German citizenship, and they called for the cancellation of the Treaty of Versailles.

Hitler was a skillful politician and organizer. He became leader of the Nazis and quickly built up party membership—partly by his ability to stir crowds with his speeches. Hitler attacked the government and declared that the Nazi Party could restore the economy, assure work for all, and lead Germany to greatness again.

Hitler also organized a private army he called *storm troopers.* He used brown-shirted uniforms and the swastika emblem to give his party and the storm troopers—known as the SA—a sense of unity and power (see **Swastika**). The troopers fought the armies of the Communist, Social Democratic, and other parties who opposed Nazi ideas or tried to break up Nazi Party rallies. By October 1923, the storm troopers numbered 15,000 members. They had a considerable number of machine guns and rifles.

The Beer Hall Putsch. In 1923, Germany was in deep trouble. France and Belgium had sent troops to occupy the Ruhr District, the chief industrial region. German workers there responded by going on strike. The strike aggravated a crisis in Germany's economy, which had already been weakened by the reparations payments, and German money lost almost all value. Communist and nationalist revolts flared up throughout Germany, and the state of Bavaria was in open conflict with the central government in Berlin. Hitler saw an opportunity amid these troubles to overthrow both the Bavarian and national German governments.

On Nov. 8, 1923, at a rally in a Munich beer hall, Hitler proclaimed a Nazi revolution, or *putsch.* The next day, he tried to seize the Bavarian government in what became known as the Beer Hall Putsch. Hitler, supported by the German General Erich F. W. Ludendorff, led over 2,000 storm troopers on a march against the Bavarian government. But state police opened fire and stopped the procession, killing 16 marchers. The plot failed. Hitler was arrested and sentenced to five years in prison.

Mein Kampf. While he was imprisoned, Hitler began writing his book *Mein Kampf (My Struggle).* In the book, he stated his beliefs and his ideas for Germany's future, including his plan to conquer much of Europe. Territories lost in World War I would be recovered. Austria and parts of Czechoslovakia where Germans lived would be added to Germany. The growing German nation would seize *lebensraum* (living space) from Poland, the Soviet Union, and other countries to the east.

Hitler also wrote that Germans represented a superior form of humanity. They must stay "pure," he said, by avoiding marriage to Jews and Slavs. Hitler blamed the Jews for the evils of the world. He accused them of corrupting everything of ethical and national value. He said: "By defending myself against the Jews, I am doing the Lord's work." Democracy, said Hitler, could lead only to Communism. A dictatorship was the only way to save Germany from the threats of Communism and Jewish treason.

Rise of the Nazis. Hitler was freed about nine months after his trial. He left prison in December 1924.

Great changes had taken place in Germany during 1924. A schedule for Germany's reparations payments helped stabilize the German currency, and the nation showed signs of recovering from the war. Most people had work, homes, food, and hope for the future.

The government had outlawed the Nazis after the Beer Hall Putsch. Many party members had drifted into other political groups. After Hitler was released from prison, he began to rebuild his party. He gradually convinced the government that the party would act legally, and the government lifted its ban on the Nazis. Hitler won friends in small towns, in labor unions, and among farmers and a few business people and industrialists. He also set up an elite party guard, the *Schutzstaffel,* known as the SS. By 1929, though the Nazis had not yet gained substantial voter support, their organization and discipline had made them an important minority party.

By this time, Hitler had assembled some of the people who would help him rise to power. They included Joseph Goebbels, the chief Nazi propagandist; Hermann Goering, who became second in command to Hitler; Rudolf Hess, Hitler's faithful private secretary; Heinrich Himmler, the leader of the SS; Ernst Röhm, the chief of the SA; and Alfred Rosenberg, the party philosopher.

In 1930, the worldwide Great Depression hit Germany. Workers again faced unemployment and hunger. That same year, Germany agreed to the Young Plan of 1929 to reschedule reparations payments. In 1929, Hitler had launched a nationwide campaign to defeat the plan. This campaign helped him become a major political force throughout the country. He led protest marches, organized mass meetings, and delivered speeches all over Germany.

Hitler used his old arguments in the campaign against the Young Plan and in a national election campaign that took place in 1930. But he toned down his violent speeches against Jews, which had failed to attract many votes. Hitler promised to rid Germany of Communists and other "enemies" and to reunite Germany and all the other parts of Europe in which German was spoken.

In 1932, five major elections were held in Germany as its leaders struggled to give the nation political stability. In the July elections for the *Reichstag* (parliament), the Nazis became Germany's strongest party, receiving nearly 38 per cent of the vote. Leaders of the other parties offered Hitler Cabinet posts in exchange for Nazi support. But as leader of the strongest party, he refused to accept any arrangement that did not make him *chancellor* (prime minister) of Germany.

The majority of the German people and the leading politicians did not want Hitler to become chancellor. They understood that he would make himself dictator and set up a reign of terror. Germany's president, Paul

von Hindenburg, also had serious misgivings about Hitler. But the 85-year-old Hindenburg, persuaded by his friends and his son Oskar, accepted Hitler's promise to act lawfully if he were named to form a government. On Jan. 30, 1933, Hindenburg named Hitler chancellor.

Dictator of Germany

There were only two Nazis in the Cabinet besides Hitler—Goering and Wilhelm Frick. The rest of the 11-member Cabinet was made up of politicians who were more moderate than the Nazis. The vice chancellor, Franz von Papen, and his political allies thought this arrangement would limit Hitler's power. But Hitler had never settled for anything less than full control. He moved steadily toward dictatorship. There was no place for freedom under his government, which Hitler called the *Third Reich* (see **Reich**).

The New Order. The Nazis, through Frick's key position as minister of the interior, controlled all national police authority. Goering controlled the Prussian police. An emergency decree signed by Hindenburg on Feb. 4, 1933, gave the Nazis legal authority to prohibit assemblies, to outlaw newspapers and other publications, and to arrest people on suspicion of treason. The Nazis were thus able to put down much of their political opposition. Goering created an auxiliary police force made up of thousands of storm troopers and ordered them to shoot in encounters with "enemies."

On Feb. 27, 1933, a fire began that destroyed the Reichstag building. Many historians believe that it was planned by the Nazis. A pro-Communist Dutch anarchist was found at the site of the fire and admitted that he had set it. The Nazis quickly blamed the Communists. Hindenburg signed another emergency decree that gave the government almost unlimited powers.

Elections for a new Reichstag were held on March 5, 1933. Hitler hoped to win more than 50 per cent of the vote for the Nazi Party. But the party received only 43.9 per cent despite using terror to influence voters.

After the election, the Communist deputies were arrested or not admitted to the Reichstag. This gave the Nazis a majority of the seats. On March 23, 1933, the Nazi-dominated Reichstag passed a law "for the removal of distress from the people and the state." This law, known as the Enabling Act, gave the government full dictatorial powers and, in effect, suspended basic civil and human rights for four years. When the president had signed it, Hitler had a firm "legal" basis on which to govern as he pleased. He had also destroyed the constitution through outwardly legal means.

By mid-July 1933, the government had outlawed freedom of the press, all labor unions, and all political parties except the Nazis. The *Gestapo* (secret state police) hunted down the enemies and opponents of the government. People were jailed or shot on suspicion alone. By the time Hindenburg died in August 1934, Hitler ruled Germany completely. He assumed the title *Führer und Reichskanzler* (leader and reich chancellor).

The Nazis used the press, radio, and films to flood Germany with propaganda praising the *New Order,* Hitler's term for his reordering of German society and for his plans to reorder the rest of Europe. The regime applauded military training, rearmament, national pride, and industry. Jews were forced out of the civil service, universities and other schools, and the professions and managerial positions. In 1935, German Jews were declared citizens of lesser rights. Thousands left the country. Many who stayed were sent to concentration camps along with hundreds of thousands of political suspects. A person needed official permission to accept work, change jobs, move, or travel abroad. The government regulated wages, housing, and production of goods. All workers and employers were supposed to belong to the German Labor Front, which was intended to replace Germany's labor unions. Through the Labor Front, the government regulated production, wages, working hours, and leisure activities.

Hitler also set up organizations for young people between the ages of 6 and 18. These groups included the *Hitler Youth* for boys 14 years and older and the *Society of German Maidens* for girls 14 years and older. The organizations were designed to condition German children to military discipline and to win their loyalty to the Nazi government. All German children were required to join such groups from the age of 10. They wore uniforms, marched, exercised, and learned Nazi beliefs.

Pictorial Parade

Paul von Hindenburg, the president of Germany, named Hitler *chancellor* (prime minister) on Jan. 30, 1933. By the summer of 1933, Hitler had made himself dictator.

European Picture Service

Nazi rallies featured thousands of troops and deeply impressed the German people. Hitler used the rallies to persuade the nation to accept his plan of conquest for Germany.

Brown Bros.

Hitler and his Nazi Party aides gained full control of Germany in 1933 and started World War II in 1939. Hitler's chief aide at the beginning of the war was Hermann Goering, at Hitler's left.

The Nazis taught children to spy on their own families and report anti-Nazi criticism they might hear.

A network of spies kept watch on the German people and maintained an atmosphere of terror. The Reichstag met only to listen to Hitler's public speeches. Judges and courts continued to function, but Hitler or his lieutenants reversed any decision they did not agree with.

The road to war. From 1933 onward, Hitler prepared Germany for war. He rearmed the nation, first secretly, then in open violation of the Treaty of Versailles. No nation acted to stop him, and so Hitler's steps became bolder. Hitler planned to establish Germany as the world's leading power and to destroy the Jewish people.

In 1936, Hitler sent troops into the Rhineland, again violating the Treaty of Versailles. His generals had opposed this dangerous challenge to France. But Hitler guessed correctly that France would not stop him. The stationing of German troops in the Rhineland was the first of the Nazi dictator's victories without war.

In March 1938, Hitler's troops invaded Austria. Austria then became part of Germany. In September, France and the United Kingdom consented to Hitler's occupation of the German-speaking areas of Czechoslovakia that had belonged to Austria-Hungary before World War I ended (see **Munich Agreement**). After this move, Hitler said he wanted no more territory. But after each success, he planned a new take-over. He took control of the rest of Czechoslovakia in March 1939.

Poland came next on Hitler's list. But the United Kingdom and France took action to try to stop any further German expansion. They guaranteed Poland's independence, saying that they would go to war against Germany if Hitler attacked Poland. Hitler doubted that they would. In August 1939, Germany and the Soviet Union signed treaties of friendship. They promised mutual cooperation, trade privileges, and neutrality in case of war with other countries. In a secret part of the treaties, the two nations planned to work to divide much of eastern Europe, including Poland, between themselves. On Sept. 1, 1939, Germany invaded Poland. The United Kingdom and France declared war on Germany two days later.

World War II. Hitler's armies overran Poland in just a few weeks. In the spring of 1940, they easily conquered Denmark, Norway, the Netherlands, Belgium, Luxembourg, and France. Benito Mussolini, Italy's dictator, declared war on France and the United Kingdom on June 10, 1940, when the defeat of France seemed certain. On June 22, 1940, France signed an armistice with Germany.

The United Kingdom fought on alone. A major German air offensive failed to weaken British resistance. Hitler kept delaying an invasion of the United Kingdom. Instead, he considered invading the Soviet Union. He explained to his generals that the United Kingdom would not surrender until its last potential ally on the European continent had been defeated.

In June 1941, the attack on the Soviet Union began. At first, the German forces made rapid progress. But their advance began to slow in November. By December, it was halted outside Moscow. An unusually bitter winter, Soviet reinforcements, and supplies sent by the United States helped the Soviet forces stop the Germans and begin to push them back during the winter. Renewed German attacks in 1942 and 1943 could not break through. During the Battle of Stalingrad, which lasted for five months during 1942 and 1943, the Soviets wiped out an entire German army of 300,000 men. This German defeat was a major turning point in the war.

While his empire lasted, Hitler directed the storm troopers, Nazi officials, and members of the army and the civil service in a campaign of mass slaughter. About 6 million Jews—over two-thirds of the Jews of Europe—were murdered. More than 3 million Soviet prisoners of war were starved and worked to death. Hitler's victims also included large numbers of Gypsies, Poles, Slavs, Jehovah's Witnesses, priests and ministers, mental patients, and Communists and other political opponents.

The German resistance had tried since 1938 to kill Hitler and overthrow the Nazis. But repeated plots failed. On July 20, 1944, Hitler narrowly escaped death when a German Army officer placed a bomb in Hitler's briefing room.

Early in 1945, the Allies marched into Germany. For a detailed story of Germany in the war, see **World War II**.

Death. By April 1945, Hitler had become a broken man. His head, hands, and feet trembled, and he was tortured by stomach cramps. Eva Braun, Hitler's mistress since the 1930's, joined him at his headquarters in a bomb shelter under the Reich Chancellery in Berlin. She and Hitler were married there on April 29. The next day, they killed themselves. Aides burned their bodies. Seven days later, Germany surrendered.

Peter Hoffmann

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Outline

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Questions

As a young man, what did Hitler want to study?
What was the Beer Hall Putsch? *Mein Kampf?*
Why was Hitler named chancellor of Germany?
How did Hitler touch off World War II?
How did Hitler win the support of the German people?
What were Hitler's main goals as dictator?
Why did Hitler order the invasion of the Soviet Union during World War II?
Why did no nation challenge Hitler before 1939?
How did Hitler set young Germans against their parents?
As a boy, how did Hitler anger his father?

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Hittites, *HIH tyts,* were the earliest inhabitants of what is now Turkey to be recorded in history. They began to control the area about 1900 B.C. During the next several hundred years, they conquered parts of Mesopotamia and Syria. By 1500 B.C., the Hittites had become a leading power in the Middle East. Hittite culture and language were Indo-European, but scholars do not know whether the Hittites came from Europe or from central Asia.

Way of life. Many elements of Hittite architecture, art, literature, and religion were influenced by neighboring peoples. The Hittites' system of government was more advanced than that of many of their neighbors. Their legal system was fair and humane, and their law code emphasized compensation for a wrong, rather than revengeful punishment. The Hittites established peaceful and profitable relations with the peoples they conquered. Their military superiority resulted from several innovations. The Hittites were among the first to smelt iron. They also built the lightest and fastest chariots of their time.

The Hittites used the Akkadian language written in cuneiform for their international correspondence. For their own royal and religious writings, they used the Hittite language recorded either in Hittite hieroglyphic writing or in cuneiform script borrowed from the Mesopotamians. Scholars deciphered the cuneiform in the early 1900's. But the scholars could not definitely decipher the hieroglyphs until 1947, when they found lengthy statements in both the Phoenician language and Hittite hieroglyphs. These bilingual documents provided scholars with the key for translating Hittite hieroglyphs.

Odyssey Productions

A Hittite banquet appears in relief on this stone slab, which was carved during the 800's B.C.

History. The Hittites penetrated what is now central Turkey shortly after 2000 B.C. They conquered the local people and set up a number of city-states. The most important of these was Hattusas, located just east of the present Turkish capital, Ankara. When the city-states formed the Hittite empire, about 1650 B.C., Hattusas became the capital.

The Hittites conquered Babylon about 1595 B.C. They also gained control of northern Syria. The widow of an Egyptian pharaoh, probably Tutankhamen, asked the Hittite emperor to send one of his sons to be her husband and pharaoh of Egypt. But a group of Egyptians who did not like this arrangement murdered the son before the marriage.

One of the greatest battles of ancient times took place about 1285 B.C. at Kadesh on the Orontes River, north of Palestine. Mutwatallis, the Hittite leader, fought an indecisive battle against Egyptian forces under Ramses II, who barely escaped alive. The Hittites did not conquer Egyptian territory. They concluded a peace that was sealed by the marriage of a Hittite princess to Ramses. See **Ramses II**.

Shortly after this, allies of the Hittites in both east and west revolted. Tribes migrated from their homes around the Aegean Sea into the western part of the Hittite empire to escape the growing power of the Greeks. They burned Hattusas in about 1200 B.C. Hittite city-states continued to exist for another 500 years, but they were not very powerful. Carchemish came to be considered the eastern capital of the Hittites. However, Sargon II of As-

syria captured it in 717 B.C. This marked the end of a distinct Hittite government.

The Hittites are mentioned several times in the Old Testament. Abraham bought the field and cave of Machpelah from Ephron the Hittite as a burial place for his wife Sarah. Abraham's grandson, Esau, married two Hittite wives. As late as the time of David, certain people of Israel were called Hittites. David had Uriah the Hittite killed in battle so that he could marry Uriah's wife, Bathsheba. Leonard H. Lesko

HIV. See AIDS (Cause).

Hive. See Bee.

Hives are a form of skin rash that comes suddenly and disappears without leaving a trace. Hives are usually a reaction to *histamine,* a substance in the body that often causes allergy. The rash consists of white or red *wheals* (raised patches) that itch. Hives may be caused by a variety of substances to which the sufferer is allergic or hypersensitive. A person may be allergic to a food or drug, or to a substance that is inhaled, such as dust or pollen. Patients also may become allergic to a substance after they come in contact with it. For example, people may become allergic to chemicals they touch frequently or to an animal's fur. An outbreak of hives often may be treated with antihistamine drugs or by bathing the spots with lotions of baking soda and water, witch hazel, or some other cooling solution.

Hives are also known as *nettle rash.* The medical name for hives is *urticaria.* Joan S. Gallagher

See also Allergy.

HMO. See Managed care plans.

Hmong, *mawng,* also called *Meo* or *Miao,* are a mountain people from southern China and northern areas of Laos, Myanmar, Thailand, and Vietnam. Hmong communities are also found in other countries, including Australia, Canada, France, and the United States. Worldwide, there are about 8 million Hmong.

Traditionally, the Hmong have farmed for a living. Their language is in the Sino-Tibetan group of Asian languages, which includes Chinese. A *shaman* (priest) plays a central role in the Hmong religion. Hmong women are famous for their needlework, which they use to decorate such items as skirts and baby carriers.

The Hmong culture probably originated in what is now central China about 4,000 years ago, before China's first dynasty began. As China's civilization expanded, it pushed the Hmong into remote mountain regions. Hmong farmers began migrating into Southeast Asia in the 1800's. Beginning in the 1950's, Hmong soldiers fought the Communist Pathet Lao movement in Laos, and some Hmong later assisted U.S. forces during the Vietnam War. After the war ended in 1975, the Pathet Lao gained control of Laos and persecuted and imprisoned many of the Hmong allies of the United States. Between 1975 and the early 1990's, about 100,000 Hmong fled to the United States and Canada. Most of them settled in urban areas. Eric Crystal

Hnatyshyn, *na TIHSH ehn,* **Ramon John** (1934-), was governor general of Canada from 1990 to 1995. As governor general, he served as the representative of the British monarch, who is also Canada's head of state. Hnatyshyn succeeded Jeanne Mathilde Sauvé in the largely ceremonial office. Hnatyshyn was the son of a Ukrainian immigrant father. Many people approved of his selection as governor general because it reflected Canada's ethnic variety.

Hnatyshyn was born on March 16, 1934, in Saskatoon, Saskatchewan. He attended the University of Saskatchewan and became a lawyer. Hnatyshyn was elected to Parliament in 1974. He held the seat as an opposition member and as a member of the Cabinet, in which he served as minister of energy and, later, justice minister. He was popular with members of all parties because of his sense of humor and harmless practical jokes. Hnatyshyn was defeated in the 1988 parliamentary elections. He then resumed his law career. Kendal Windeyer

Ho Chi Minh, *hoh chee mihn* (1890-1969), a Vietnamese revolutionary leader, served as president of North Vietnam from 1954 until his death. Ho gained popularity when his forces defeated the French rulers of Vietnam in 1954. In the 1950's and 1960's, Ho's Communist government sent troops to aid rebels in South Vietnam who were trying to overthrow the anti-Communist government there. Ho's followers continued to aid the rebels after his death and, in 1975, the Communist forces won control of South Vietnam.

Ho was born Nguyen Van Thanh on May 19, 1890, in central Vietnam. He became a Communist in 1920 and helped found the French Communist Party. At the end of World War II (1939-1945), Ho became head of a Vietnamese government that opposed France's rule. In 1946, fighting broke out between the French and Ho's troops, known as the Vietminh. After the Vietminh defeated the French in 1954, an international conference divided Vietnam into two nations. Ho then became president of North Vietnam. Bernard B. Fall

Tetlow, Pictorial Parade

Ho Chi Minh

See also Indochina (Independence); Vietnam (History); Vietnam War.

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Ho Chi Minh City, *hoh chee mihn* (pop. 3,934,395), is Vietnam's largest city and most important economic center. Ho Chi Minh City lies on the Saigon River in southern Vietnam about 45 miles (70 kilometers) from the South China Sea. For location, see Vietnam (map). Ho Chi Minh City was known as Saigon until 1975, and many of the city's residents still refer to it by that name.

Ho Chi Minh City has many treelined streets and wide boulevards. The city's architecture includes old Chinese structures, French colonial buildings, and modern high-rise offices and apartments. Landmarks include the Roman Catholic Notre Dame Cathedral; the Buddhist Giac

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Ho Chi Minh City is Vietnam's largest city and most important economic center. The city, which lies in southern Vietnam, has a number of broad boulevards and high-rise buildings.

Lam Pagoda, which was built in 1744 and is the oldest of the city's numerous pagodas; and the History Museum, which houses artifacts from Vietnam's history. The University of Ho Chi Minh City is one of the largest institutions of higher learning in Vietnam.

Ho Chi Minh City's major industrial products include chemicals, clothing, consumer electronics, leather goods, and processed foods and beverages. Because of its closeness to the South China Sea, Ho Chi Minh City has developed into an important port. Tan Son Nhat International Airport serves the city.

In the 1600's, Vietnamese migrating southward arrived at a village they eventually called Saigon, which was inhabited by Khmer people from Cambodia. Chinese merchants established the neighboring community of Cholon in the late 1700's. The French seized Saigon in 1859. As French influence spread in Southeast Asia, Saigon grew from a rough river town into the largest center of business and commerce in French Indochina. It also served as the seat of colonial administration for southern Vietnam, which the French called Cochin China. Through the years, the city earned a reputation for being more cosmopolitan and business-oriented than the capital, Hanoi.

In 1954, the French agreed to withdraw from Vietnam, and the country was split in two. Saigon became the capital of the Republic of Vietnam in the southern part of the country. An economic boom based largely on American military spending made the city an island of prosperity and safety in the 1960's during the Vietnam War. The war ended with the entry of Communist forces into Saigon on April 30, 1975. The Communist government in Hanoi soon renamed Saigon, Cholon, and their suburbs together as Ho Chi Minh City, in honor of the Vietnamese Communist leader Ho Chi Minh.

Following economic reforms in the 1980's, Ho Chi Minh City grew rapidly. This rapid growth led to a number of problems, including overcrowding; shortages of housing, water, and electric power; and an increase in air and water pollution. William S. Turley

WORLD BOOK illustration by John Rignall, Linden Artists, Ltd.

The strange-looking hoatzin lives in South America. A young hoatzin has claws on its wings, which help the bird climb trees before it can fly. Adults have long, loose feathers on their head.

Hoatzin, *hoh AT sihn,* is an unusual-looking bird that lives in marshy areas near waterways in the northern part of South America. Hoatzins have claws on their wings when they hatch from the egg. The young birds use the claws to climb on tree branches until they learn to fly. The claws fall off as the birds mature.

The hoatzin has short, rounded wings and a long tail. It has bright red eyes, a blue face, and a stiff crest of brown feathers atop its head. The bird's upper body is dark brown, and its underparts are a dull yellow. The hoatzin is the size of a small chicken.

Among birds, hoatzins have a unique digestive system that uses more than one compartment to break down food. Hoatzins store and partially digest their food, mostly leaves, in a *crop* (baglike organ) before it reaches the stomach. This digestive process is similar to that of such grazing mammals as cows and deer, a fact that puzzles scientists. Hoatzins live in family groups in tree branches that hang over waters. Stuart D. Strahl

Scientific classification. The hoatzin makes up the hoatzin family, Opisthocomidae. Its scientific name is *Opisthocomus hoazin.*

Hobart, *HOH bahrt* (pop. 189,944), is the capital of the Australian island-state of Tasmania. The city lies on the Derwent River, about 12 miles (19 kilometers) from the Tasman Sea. For location, see **Australia** (political map). Most of Tasmania's trade and shipping go through the city.

The city was founded as Hobart Town in 1804 by David Collins. It was the capital when Tasmania became a separate colony in 1825. During its early days, Hobart was a major center for antarctic whalers. The city's

name was changed to Hobart in 1881.

Modern factories in the city produce cement, paper pulp, textiles, candy, and metal products. Two bridges connect the eastern and western shores of the Derwent River. Hobart is the home of the University of Tasmania and a number of scientific research laboratories.

Rod C. Boucher

Hobart, Garret Augustus (1844-1899), served as vice president of the United States under President William McKinley from 1897 to 1899. Hobart's death that year made it necessary for the Republicans to find another running mate for McKinley in the presidential election of 1900. Their choice of Theodore Roosevelt was fateful because McKinley was assassinated in 1901, and Roosevelt became president.

Hobart was born on June 3, 1844, in Long Branch, New Jersey. He graduated from Rutgers College and studied law in Paterson, New Jersey. Beginning in 1872, Hobart served for many years in the New Jersey legislature. In 1874, Hobart became speaker of the state assembly. He was elected state senator in 1876, and he became president of the New Jersey Senate in 1881. Hobart served as a member of the Republican National Committee from 1884 to 1896. Robert W. Cherny

See also **Vice President of the United States.**

Hobbes, Thomas (1588-1679), was a British philosopher. His most famous work, *Leviathan, or the Matter, Form, and Power of a Commonwealth, Ecclesiastical and Civil* (1651), was concerned with political theory. In this work, he denied that people are naturally social beings. He argued instead that people's most basic motives are selfish considerations.

Hobbes was influenced by two developments of his time. One was a new system of physics that Galileo and others were working out (see **Galileo**). From their ideas, Hobbes concluded that only matter exists and that everything that happens can be predicted in accordance with exact, scientific laws. Many people of his time believed that his view denied the existence of both God and a free human soul that is immortal. But Hobbes himself denied this.

The second great influence on Hobbes's thought was the English Civil War (1642-1648). People, he concluded, are selfish. They are moved chiefly by desire for power and by fear of others. Thus, without an all-powerful sovereign to rule them, their lives would be "poor, nasty, brutish, and short." These views also shocked his contemporaries.

Hobbes's influence. Though modern physics is not so materialistic as it seemed to be in Hobbes's day and though human motives are more complex than he supposed, Hobbes's influence continues. He raised fundamental and challenging questions about the relationship between science and religion, the relationship between thought and the physiological processes on which it is based, and the nature and limitations of political power. The questions that Hobbes raised are ones that people still struggle to answer.

His life. Thomas Hobbes was born on April 5, 1588, in Westport (now part of Malmesbury), England. He was educated at Oxford University and served as secretary to Sir Francis Bacon and as tutor to William Cavendish, who later became Earl of Devonshire. Hobbes traveled widely with Cavendish and came into contact with a large number of European philosophers and scientists.

During the English Civil War, Hobbes fled to the European continent. For a short time, he tutored the Prince of Wales, later Charles II, in mathematics. Though Hobbes returned to England while Oliver Cromwell's Protectorate was still in power, he was able to make peace with Charles II when Charles became king in 1660.

Stephen A. Erickson

Additional resources

Bobbio, Norberto. *Thomas Hobbes and the Natural Law Tradition.* Univ. of Chicago Pr., 1993.

Condren, Conal. *Thomas Hobbes.* Twayne, 2000.

Martinich, A. P. *Hobbes.* Cambridge, 1999. *Thomas Hobbes.* St. Martin's, 1997.

Sorell, Tom, ed. *The Cambridge Companion to Hobbes.* Cambridge, 1996.

Hobby can be any type of activity that people do during their leisure time. Most people take up a hobby for relaxation, pleasure, or friendships, or to develop new interests. A hobby can also lead to additional income.

People of almost any age can enjoy hobbies. A hobby offers a way to relax after periods of hard work. Hobbies offer broadened areas of interest and ways to pass the time pleasantly.

Hobbies also can be important in helping patients recover from physical or mental illness because they provide distractions from the patients' problems. For people who are ill or bedridden, hobbies offer fascinating ways to pass the time. Hobbies can also be an important form of occupational therapy.

Kinds of hobbies

Almost any kind of leisure activity can become a hobby. Most hobbies fall into one of four general categories, which may overlap. These categories are (1) the arts, (2) collecting, (3) handicrafts, and (4) games and sports.

The arts provide outlets for hobbyists with a special interest in such art forms as dancing, drama, painting, graphic arts, and music. Each art form has many separate possibilities for a hobby. For example, music may include singing or playing an instrument. Painting offers the hobbyist a wide choice of materials, such as oil paints or water colors.

Collecting is probably the most widespread kind of hobby because almost anything can be collected. Stamps and coins are probably the most popular collected items. Hobbyists also collect such things as autographs, comic books, costumes, dolls, and baseball cards.

Handicrafts attract hobbyists who can work skillfully with their hands. Many hobbyists engage in needlework activities, notably crocheting, needlepoint, knitting, and sewing. Hobbyists use kits to make model airplanes, boats, and trains. Using woodworking tools, they can create carvings, furniture, and bowls. Other handicrafts include ceramics, metalworking, jewelry making, weaving, batik, and leatherworking.

Games and sports are popular with many hobbyists who enjoy competition, physical activity, and healthful exercise. Thousands of hobbyists take part in sports, such as bowling, fishing, mountain climbing, skiing, and tennis. These sports give hobbyists the opportunity to display their individual skills and sportsmanship. Popu-

lar indoor games include bridge and other card games, backgammon, chess, and Monopoly.

Other hobbies. Electronics-related hobbies are becoming increasingly popular. Many hobbyists enjoy flying model airplanes by remote control or assembling and operating ham radios. Both young people and adults have taken up computers as a hobby, frequently assembling computers from kits. Some people raise pets as a hobby. For many people, gardening and photography are rewarding hobbies.

Starting a hobby

People sometimes choose a hobby without realizing they are doing so. A casual interest grows into a fascination as the person learns more about the subject and devotes an increasing amount of time to it. After deciding on a hobby, individuals may gather as much information as they can from reference sources, especially books and magazines. They can also gain information by taking courses in school, attending hobby conventions, and joining hobby clubs. Hobbyists often can study exhibits relating to their hobby in museums and galleries. Clubs and other organizations sponsor tours that allow hobbyists to visit places where they can pursue their hobby and meet people with similar interests.

In most cases, beginning hobbyists should start with a few basic items. As they become more experienced and enthusiastic, they may buy more elaborate materials. Hobby dealers provide information about equipment, supplies, and techniques. Dona Z. Meilach

Related articles in *World Book* include:

Arts hobbies

Art and the arts	Drawing	Music	Reading
Dance	Finger painting	Orchestra	Singing
Drama	Literature	Painting	Theater
		Poetry	

Collection hobbies

Antique	Collectibles	Leaf
Aquarium, Home	Doll	Moth
Autograph	Dollhouse	Pet
Automobile	Flower	Rock
Book collecting	Fossil	Shell
Butterfly	Furniture	Stamp collecting
Button	Insect	Tropical fish
Coin collecting		

Handicraft hobbies

Airplane, Model	Embroidery	Quilt
Appliqué	Handicraft	Railroad, Model
Astronomy	Jewelry	Rocket, Model
Automobile, Model	Kite	Rugs and carpets
	Knitting	Sampler
Basket making	Leathercraft	Screen printing
Beadwork	Macramé	Sewing
Bird (Bird study)	Mosaic	Ship, Model
Block printing	Needlepoint	Taxidermy
Bookbinding	Papier-mâché	Ventriloquism
Cooking	Petit point	Weaving
Crewel	Photography	Woodcarving
Crochet	Pottery	Woodworking
Decal	Puppet	
Decoupage		

Games and sports

See the lists of *Related articles* with Game; Play; Sports.

Other hobbies

Bee	Computer	Gardening
Radio, Amateur	Stereophonic sound system	

Additional resources

Level I

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Gould, Roberta. *Making Cool Crafts & Awesome Art.* Williamson, 1998.

Pfiffner, George. *Earth-Friendly Outdoor Fun.* Wiley, 1996.

Level II

Boyd, Margaret A. *Crafts Supply Sourcebook.* 5th ed. F & W Pubns., 1999.

Cook, Deanna F. *Disney's Family Fun Crafts.* Hyperion, 1997.

Munson, Robert S. *Favorite Hobbies and Pastimes.* Am. Lib. Assn., 1994.

Hobby, Oveta Culp (1905-1995), became the first United States secretary of health, education, and welfare. She served from 1953 to 1955.

During World War II (1939-1945), Hobby organized and directed the Women's Auxiliary Army Corps (later known as the WAC). She became the first woman to receive the Distinguished Service Medal.

In 1953, President Dwight D. Eisenhower appointed Hobby federal security administrator. She was born in Killeen, Texas. Stephen E. Ambrose

Hobson, Laura Zametkin (1900-1986), was an American novelist who wrote about controversial subjects. Her most famous novel is *Gentleman's Agreement* (1947). In it, a young reporter pretends to be Jewish to gain material for a magazine article on anti-Semitism. The reporter discovers that many well-meaning people hold prejudices and silently consent to religious intolerance.

In *The Trespassers* (1943), Hobson attacked the United States government for failing to sufficiently help European refugees before World War II (1939-1945). *The Tenth Month* (1971) concerns unwed mothers. *Consenting Adult* (1975) is about homosexuality. Other novels by Hobson include *The Other Father* (1950), *The Celebrity* (1951), *First Papers* (1964), and *Over and Above* (1979).

Laura Keane Zametkin was born in New York City, the setting for most of her fiction. She married Thayer Hobson in 1930. Hobson's autobiography, *Laura Z.: A Life* (1983), describes her life up to the publication of *Gentleman's Agreement.* Barbara M. Perkins

Hochhuth, *HAHK hoot,* **Rolf** (1931-), is a German playwright. His plays dramatize disputed moral decisions made by famous people of modern history. In *The Deputy* (1963), also known as *The Representative,* his most famous play, Hochhuth condemned Pope Pius XII for not protesting the Nazi extermination of Jews during World War II (1939-1945).

Hochhuth's second play, *Soldiers* (1967), was also set in World War II. In this drama, Hochhuth charged Prime Minister Winston Churchill of Britain with causing the death of General Władysław Sikorski, leader of Poland's government in exile. He asserted that Churchill had Sikorski killed for diplomatic reasons. He also portrayed Churchill as insensitive to the deaths of German civilians in cities bombed by the Allies.

In *Guerrillas* (1970), Hochhuth charged the United States with racial and political murders. This play portrays fictional public figures in the United States and Latin America. Hochhuth was born in Eschwege, Germany, near Kassel. Russell A. Berman

Höchstädt, Battle of. See Blenheim, Battle of.

Hockey

Hockey, also called *ice hockey,* is a fast, exciting sport played by two teams on a sheet of ice called a rink. Each team has six players on the ice, and all the players wear skates. The players skate up and down the rink, slamming a hard rubber disk called a *puck* along the ice with long sticks. They try to score points by hitting the puck into a *goal cage,* or *net.* In many countries, the term *hockey* refers to field hockey. For information on this sport, see the **Field hockey** article in *World Book.*

Hockey has swifter action than almost any other sport. As the players streak across the ice, their powerful shots and passes often send the puck traveling faster than 100 miles (160 kilometers) per hour. A goalkeeper on each team defends the team's net. Goalkeepers must often make lightning slides across the front of the net on their knees, stomach, or back to block shots of the puck. A puck that enters the goal cage or crosses the goal line scores a *goal* (point) for the other side. The side that scores the most goals wins the game. To keep the action fast, hockey has an unusual rule. It is the only major sport that allows players to be substituted while play is in progress. The game sometimes includes fights among players, though fighting is against the rules.

Hockey began in Canada in the mid-1800's. By the early 1900's, it had become Canada's national sport. Since then, hockey has become popular in many other countries, especially Russia, Sweden, and the United States. In Canada and the United States, thousands of amateur players take part in community, high school, and college contests.

Gordon Howe, the contributor of this article, ranks among the greatest players in the history of hockey. He is the author of Hockey: Here's Howe *(paperback title,* Let's Play Hockey).

How to play hockey

Hockey rules differ somewhat between professional and amateur groups. This section deals mainly with the rules followed by professional leagues in Canada and the United States. There is one major league—the National Hockey League (NHL)—plus several minor leagues. Most Canadian and U.S. amateur teams have nearly the same rules that professional leagues have. But U.S. high school and college teams follow a special set of amateur rules, as do most teams in international competition. This section notes the chief differences between the professional rules and various amateur rules.

The rink. The standard hockey rink measures 200 feet (61 meters) by 85 feet (26 meters). The corners are rounded. A low, white, solid wooden wall—called the *boards*—surrounds the rink. This wall, which in most cases is covered with fiberglass, stands 40 to 48 inches (102 to 122 centimeters) high. Most indoor rinks consist of a sheet of ice that is first painted white, with blue and red markings, and then covered with more clear ice.

A red *goal line* extends across each end of the rink, 10 feet (3 meters) from the boards. A goal cage stands in the middle of each goal line. The cage consists mainly of heavy netting supported by two metal *goal posts,* which are joined across the top by a metal crossbar. Each goal post is held in place by two short pegs. The opening at the front of the cage measures 4 feet (1.2 meters) high by 6 feet (1.8 meters) wide. Players aim the puck at this opening to score goals. An 8-foot (2.4-meter) by 4-foot (1.2-meter) area, called a *goal crease,* is outlined in red in front of each cage. A player may not enter the opposing team's crease unless that player is going after

Mitchell Layton, Duomo

Hockey is an exciting sport known for its fast, rough action. Hockey is played on ice by two teams of six players. Each team tries to score by shooting a puck into the opponent's goal.

the puck. A goal does not count if an offensive player was in the crease when the puck crossed the goal line, unless an opponent forced the player into the crease.

Two blue lines divide the area between the goal lines into two 60-foot (18-meter) end zones and a center zone, which is 58 feet long in the NHL. The end zone that a team defends is that team's *defending zone*. The opposite end zone is the team's *attacking zone*. One team's defending zone serves as the other team's attacking zone. The center zone is called the *neutral zone*. In all hockey games, except U.S. high school and college games, the rink also has a red *centerline*. It divides the neutral zone—and the rink—in half. Nearly all outdoor rinks have the zone boundaries marked on the boards.

Colored *face-off spots* mark the places on the ice where officials hold *face-offs*. In a face-off, an official drops the puck between the sticks of two opposing players, who try to hit it to a teammate or toward the opponents' goal. Face-offs are used to begin each game and to resume play after it has been stopped. The neutral zone has four red face-off spots, and each end zone has two. Each end zone face-off spot is surrounded by a red circle. Only an official and two opposing players may stand inside a circle during a face-off. A blue face-off spot and circle are at the center of the rink.

Most hockey rinks have a *players' bench* for each team and a *penalty bench,* or *penalty box,* where players must stay temporarily if they break the rules. The benches are behind the sideboards. Every rink has two or more clocks to keep track of the playing time and the time players serve in the penalty box. Most indoor rinks also have a red light behind each goal that is flashed on when a puck enters the goal cage and scores.

Playing time. Most hockey games are played in three 20-minute periods separated by two 15-minute intermissions. The periods last less than 20 minutes in some amateur games. Only actual playing time is counted. The clock stops when play stops. An official's whistle stops play in most cases. In addition, each team is allowed one 30-second time out per game.

In the NHL, if a regular-season game ends in a tie after three periods of play, the teams play a 5-minute *sudden-death overtime*. The first team to score in the overtime wins. If neither team scores, the game ends in a tie. If an NHL play-off game ends in a tie, the teams play 20-minute overtime periods until one team scores.

The starting lineup consists of the goalkeeper, or *goalie;* three *forwards;* and two *defensemen*. The goalie has the most demanding job on the team. The goalie is the last defense against a score by the opposing team, and the least mistake on the goalie's part may cost the

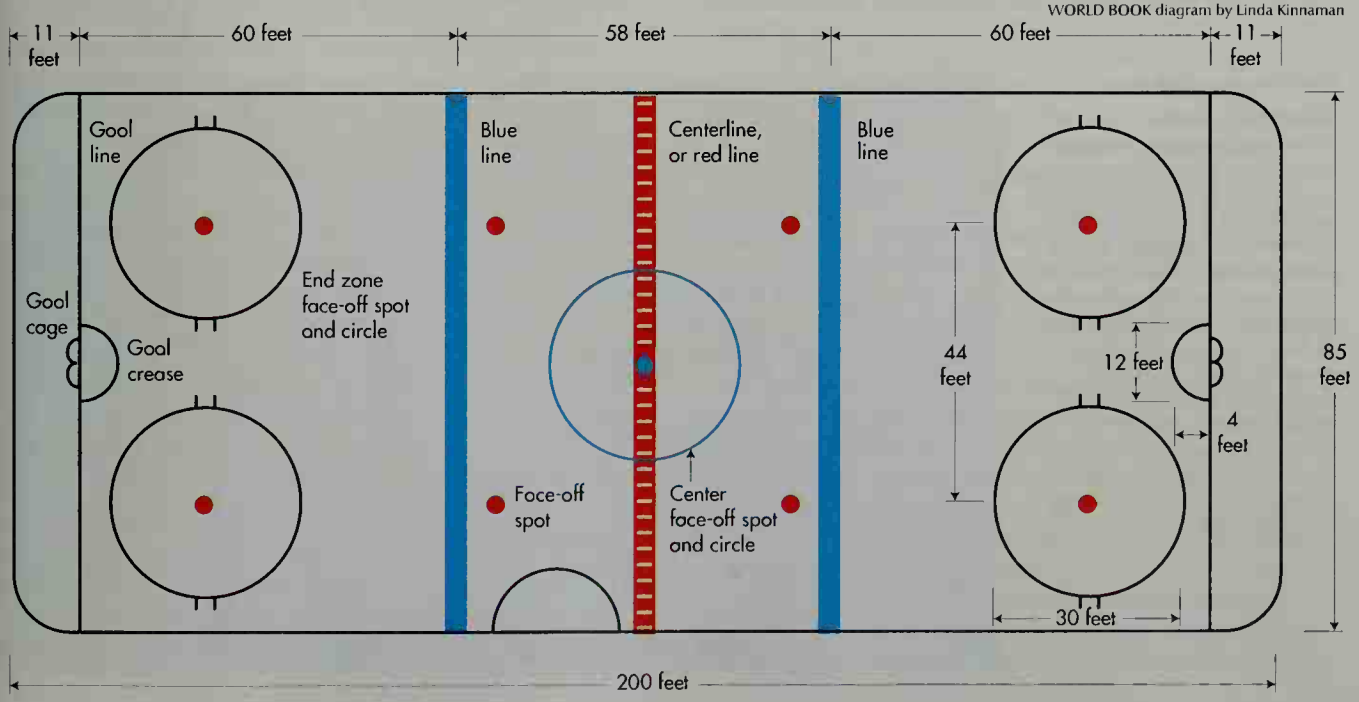
Hockey terms

Assist is a pass that leads to a goal. It counts as one point in individual scoring statistics.
Breakaway occurs when a player gains control of the puck and skates past the defenders for a clear shot at the goal.
Centering the puck happens when a player passes the puck to a spot in front of the opponent's goal.
Deke is the term for faking an opponent out of position.
Draw is another name for the face-off.
Hat trick is the term for three goals scored by one player during a game.
Pulling the goalie is an offensive strategy in which a team replaces its goalkeeper with another skater to increase that team's offensive attack.
Screen shot is a shot on goal in which the goalkeeper's vision is partially or completely blocked by another player in front of him.
Shot on goal is a shot at the goal that would go into the net if not stopped or deflected.

A standard hockey rink

Almost all professional and many amateur rinks are laid out like the one shown here. Other rinks differ in certain ways. In some amateur rinks, for example, the blue lines are less than 60 feet from the goal lines. But they still divide the area between the goals into three zones. In U.S. high school and college hockey, the rink does not have a centerline.

WORLD BOOK diagram by Linda Kinnaman



WORLD BOOK photo

Fighting for control of the puck often sends players slamming into the boards that surround a hockey rink. Fans close to the rink watch through specially treated protective glass.

team a goal. The goalie almost always remains in or near the goal crease. The goalie is the only player allowed to catch the puck or pick it up.

The main job of the forwards is to score goals. But they must also help defend their team's goal. Each forward has an assigned position—*center, left wing,* or *right wing*—which together make up the *forward line.* The center usually leads the team's attack and takes part in most face-offs. The center's starting position is in the middle of the forward line. But during play, the center chases the puck wherever it goes. The left wing generally patrols the left side of the rink. The right wing patrols the right side. But the wings skate into each other's territory when the play requires.

The defensemen's main job is to guard their team's defending zone and so keep the opposing team from scoring. But defensemen also sometimes lead the attack and score goals. They normally cover the part of the rink between their team's forward line and their goal. The *left defenseman* generally covers the left half of the rink, and the *right defenseman* covers the right half. But like the wings, they skate into each other's territory when necessary. The sections on *Offensive play* and *Defensive play* describe the players' duties in more detail.

Players may be substituted at any time, but play is never stopped to make substitutions. Coaches usually change the forward line and both defensemen about every 2 minutes during professional games. The starting goalie usually plays the entire game. A team often has to play *short-handed*—that is, with fewer players on the ice than the opposing team has. This situation occurs when one or two players on a team are in the penalty box.

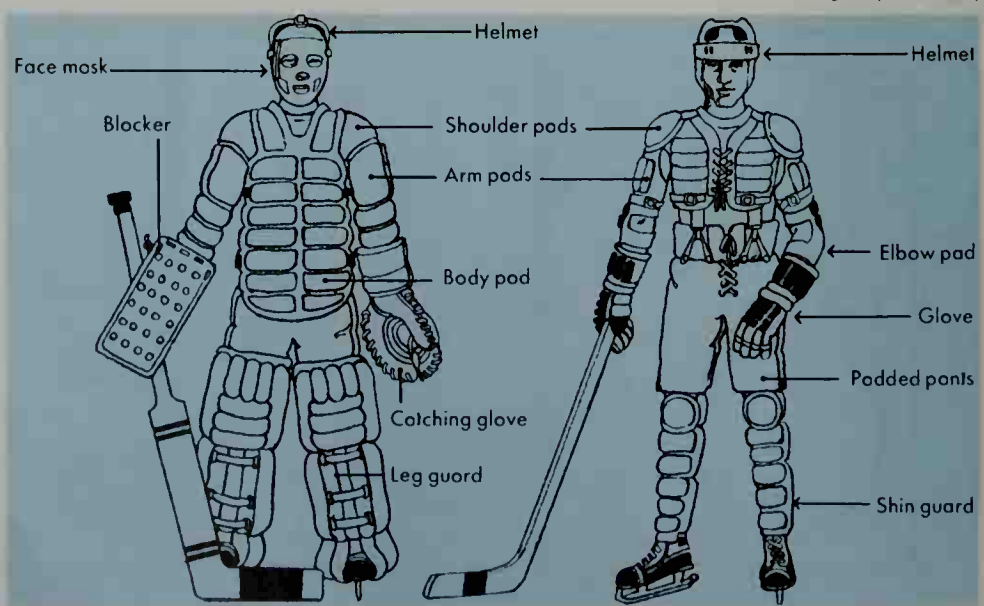
Equipment. Hockey players need a puck, skates, and sticks. The puck is a hard, black rubber disk 1 inch (2.5 centimeters) thick and 3 inches (7.6 centimeters) in diameter. It weighs from $5\frac{1}{2}$ to 6 ounces (156 to 170 grams). Hockey skates have strong, light nylon and leather shoes designed for both support and protection. The blades are made of hard steel and are *rockered* (curved) along the bottom. A player can turn and make other maneuvers more easily with rockered blades than with flat ones. Each player uses an L-shaped stick. The *shaft* (handle) is made of wood or metal and may be no more than 55 inches (140 centimeters) long. The *blade* of the stick is wooden. Except on goalies' sticks, the blade must be no more than $12\frac{1}{2}$ inches (32 centimeters) long and 3 inches (8 centimeters) wide. The blade of a goalie's stick may be up to $15\frac{1}{2}$ inches (39 centimeters) long and $3\frac{1}{2}$ inches (9 centimeters) wide.

A player's uniform consists mainly of knee-length pants, a sweater, and long socks. Under the uniform, each player wears shoulder pads, elbow pads, a garter belt, and shin guards. Male players wear a special supporter. The pants of all players are padded to protect the kidneys and thighs. In addition, each player also wears heavily padded gloves with long cuffs to protect the wrists. Nearly all amateur players must wear a protective helmet. Players in the NHL also must wear a helmet. Many players' helmets are equipped with a clear plastic

Hockey equipment

Skates and a stick are part of every hockey player's equipment. Every player also wears special protective equipment, as shown in these drawings. The left-hand drawing shows a goalie's equipment. It is specially designed to protect the goalie against bulletlike shots of the puck. The right-hand drawing shows the equipment of the other players. In addition to this equipment, defensemen and some forwards wear ankle guards. Players may also wear protective face masks.

WORLD BOOK diagram by James Buckley



shield that protects the upper part of the face.

A goalie wears extra-thick padding under the uniform, including pads to protect the arms and the front of the body. A leather pad 10 inches (25 centimeters) wide shields the front of each leg from above the knee to below the ankle. These pads help the goalie block shots at the net. One of a goalie's gloves, called a *blocker,* has a large pad on the back. The goalie uses this pad, along with the stick, to bat away lightning shots of the puck. The other glove resembles a first baseman's mitt with a long cuff. The goalie uses this glove to catch pucks and toss them away from the net. Goalies also wear a special protective face mask.

Hockey skills. Hockey requires a variety of skills. They include (1) skating, (2) stickhandling, (3) passing, (4) shooting, and (5) checking. Hockey has few standard plays, and so players must also have the skill to develop plays as the action progresses.

Skating is the most important hockey skill. Players must be able to turn sharply, skate backwards, and perform many other maneuvers—all at top speed. Their skating must be so automatic that they can make any maneuver without taking their attention from the game.

Stickhandling is the use of the stick to control the puck. In the most common form, a player moves the puck first with one side of the blade and then with the other while skating. The player makes some sweeps of the stick wide and some narrow. In this way, the player keeps the opponents guessing as to the next move and also makes it difficult for them to steal the puck.

Passing is the means by which a player who has possession of the puck transfers it to a teammate. In most cases, players use their sticks to propel the puck toward a receiver. Such passes are either *flat passes* or *flip passes.* To make a flat pass, the passer sends the puck traveling along the surface of the ice. To make a flip pass, the player causes it to rise off the ice to avoid interception by an opponent. Sometimes, a passer simply leaves the puck behind so that a teammate can get it. Such a pass is called a *drop pass.*

Shooting is the skill needed to drive the puck into the goal cage and so score goals. As in passing, a player propels the puck with the stick. Most shots are either *wrist shots* or *slap shots.* In a wrist shot, the blade does not leave the ice. The player uses strong wrist action to propel the puck. For a slap shot, the player raises the stick in a backswing and brings it down against the puck with great force. Slap shots are more powerful but less accurate than wrist shots.

Checking is the chief means a player uses to get the puck away from an opponent. There are two main types of checks: *stick checks* and *body checks.* For a stick check, a player uses the stick to hook or poke the puck away from an opponent's stick. In a body check, a player bumps against an opponent with a hip or shoulder to try to block the opponent's progress or throw the opponent off balance. Both stick checking and body checking are allowed only against a player in control of the puck or the last player to control it. In professional and most amateur play, body checks may be made anywhere on the ice. In U.S. high school and college hockey, they are allowed only in the defending and neutral zones.

A goalie needs a special set of skills. To block shots at the net, the goalie must be able to move nearly every part of the body and all the equipment quickly, surely, and almost automatically.

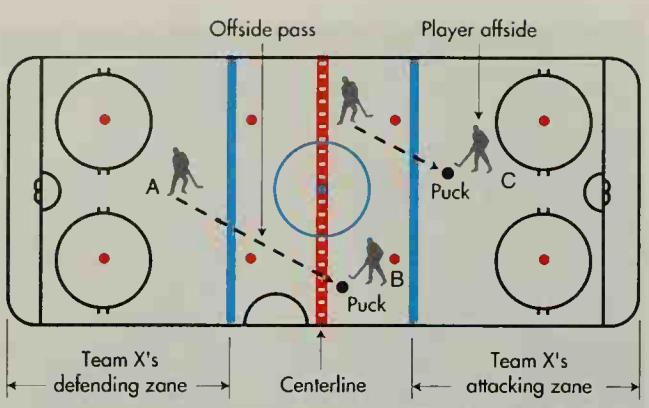
Focus on Sports

A face-off begins each period and starts play after a game has been stopped for any reason. An official drops the puck between two opposing players, who try to hit it to a teammate.

Playing the game. Each period begins with a face-off at the center face-off spot. A face-off also starts play again after it has been stopped for any reason. These face-offs are held at various face-off spots, depending on the reason for stopping play. The team that gains control of the puck as a result of the face-off tries to move it into scoring position. During play, the puck must normally be kept moving. If it is hit over the boards, held by the goalie, out of the referee's sight, frozen between opposing players, or is otherwise temporarily out of play, an official blows a whistle for a face-off. The only exception to this rule occurs when the puck is stationed along the boards while players try to get possession of it.

A player may *carry* (move) the puck along the ice, pass it to a teammate, or shoot it at the goal. But the rules limit these plays in certain ways. One extremely important rule states that no player of an attacking team may be in the attacking zone ahead of the puck. One member of the team must carry or shoot the puck across the attacking blue line before any other player on the team crosses the line. For violations of this rule, an official signals the offending team *offside* and conducts a face-off in the neutral zone. If an attacking player has crossed into the opposing team's defending zone ahead of the puck, that player can prevent an offside call by immediately returning to the center zone and then re-entering the opposing team's zone. This action is called *clearing the zone.* Offside must be called, however, if the puck shot by an attacking player has a chance to go into the net or if an attacking player touches the puck before the zone has been cleared.

A player may pass to a teammate anywhere in the same zone. The player may also pass from the defending zone to a teammate in their team's half of the neutral zone. If the pass is received beyond the centerline, an official signals the pass offside and conducts a face-off where the play began. In games that are played without a centerline, a player may pass from the defending zone



WORLD BOOK diagram by Linda Kinnaman

Offside plays rank among the most common hockey violations. There are two types of offsides, illustrated above by players on Team X. An *offside pass* violation occurs when a player (A) hits the puck from the defending zone to a teammate (B) across the centerline. A *player offside* violation occurs when a player (C) enters his or her team's attacking zone ahead of the puck.

to a teammate anywhere in the neutral zone.

Offensive play centers on the attack, or *rush,* against the opposing team's goal. An attacking team moves the puck down the ice until one player is in position to carry or shoot it across the defending team's blue line. If the player carries the puck across the blue line, teammates rush to an open area to receive a pass. If the player shoots the puck across the blue line, one or more teammates rush in to gain control of the puck. But a player remains back for defensive purposes in case the other team gets control of the puck.

Once the attackers control the puck in the opposing team's end zone, the attacking defensemen station themselves as *point men* at opposite ends of their opponents' blue line. Their main job is to keep the puck in the attacking zone. The center tries for shots at the goal or passes the puck to a wing in better scoring position. The center and one of the wings go after any shot that misses the goal or is batted away by the goalie and try to score it on the *rebound.* If the opposing team gets the puck, the attackers quickly begin checking to regain control. Checking an opponent who controls the puck in the opponent's defending zone is called *forechecking.* Throughout an attack, one wing must always play far enough back to go after an opponent who breaks into the neutral zone with the puck.

The most spectacular offensive play is the *power play.* This play occurs when one team is short-handed. The other team sends all its players except the goalie into the attacking zone in an all-out drive to score.

Defensive play is designed to break up attacks. At the start of an attack, both defensemen begin skating rapidly toward their defending zone. They skate backward to keep close watch on the attackers and use their sticks to prevent a pass or a shot at the goal. Each defending wing guards the attacking wing on the defending wing's side of the ice. After the puck crosses the defending team's blue line, one defenseman takes a position in front of the goalie. The other defenseman guards the puck carrier. The defending center goes after the puck. Each defending wing guards the attacking defenseman stationed on the wing's side of the ice as a point man. All the defending players must check strongly. Their chief aim is to get control of the puck and carry or pass it out of their end zone. Checking to break up an attack is called *back-checking.* To defend themselves against power plays, teams may send in substitutes called *penalty killers.* These players are expert at back-checking and keeping control of the puck.

An illegal defensive play called *icing the puck,* or *icing,* occurs when a defending player shoots the puck from the defending team's half of the ice across the opponents' goal line. But for icing to occur, a player on the other team must be the first player to touch the puck after it crosses the goal line. In games played without a centerline, icing occurs when a player shoots the puck from the defending zone across both blue lines and the opponents' goal line. The penalty for icing is a face-off in the offending team's end zone. There are two major exceptions to the icing rule. If an iced puck enters the net, it counts as a score. In addition, a short-handed team may ice the puck as a defensive play.

Violations and penalties. Offside plays and icing account for most violations of the rules. For these violations, the offending team risks losing the puck in the resulting face-off. For more serious violations, players receive penalties ranging from 2 minutes in the penalty box to removal from the game. But a team must always have at least four players on the ice. If a third player is penalized while two teammates are in the penalty box, a substitute may replace the player on the ice. The third player's penalty time does not begin until the first penalized player has served the penalty. But this player may not return to the ice until play is stopped. The substitute must then leave the ice. A teammate may serve a goalie's penalties in most cases.

Hockey has five main kinds of penalties: (1) minor penalties, (2) major penalties, (3) misconduct penalties, (4) match penalties, and (5) penalty shots.

Minor penalties are given for such violations as holding or tripping an opponent or hooking an opponent with a stick. They bring 2 minutes in the penalty box. The team must play short-handed until the penalty is served or until the other side scores a goal. But if the same minor penalty is awarded against a player on each team at the same time, substitutes may replace both players.

Major penalties are given mainly for fighting or for cutting or drawing blood with a stick. They bring 5 minutes in the penalty box. The penalized team must play short-handed, and the entire penalty must be served. But if a player on each team receives a major penalty at the same time, substitutes may replace both players on the ice.

Misconduct penalties are given chiefly for improper behavior toward an official. A misconduct penalty brings 10 minutes in the penalty box, but a substitute may replace the penalized player. A *game misconduct penalty* is given chiefly for more serious offenses against officials. In the NHL, it is also awarded against the first player to join a fight between two other players, and against a player involved in three fights in one game (two fights if the player starts the second fight). The offending player is removed for the rest of the game, but a substitute may replace him.

Match penalties are given for deliberately injuring or attempting to injure an opponent. The offending player is removed for the rest of the game. But a substitute may

replace the player after 5 or 10 minutes, depending on the seriousness of the offense.

Penalty shots are free shots at the opposing team's goal defended only by the goalie. They are chiefly awarded against a defending team when an attacking player with a clear shot at the goal is pulled down from behind and so prevented from taking the shot.

The officials. The chief officials are the *referees* and two *linesmen*. They wear skates and are stationed on the ice. The referees supervise the entire game and decide nearly all penalties. The NHL uses two referees. Other levels of competition use one. The linesmen call offside and icing violations and conduct most face-offs.

All other officials work off the ice. The *game timekeeper* keeps track of actual playing time. The game timekeeper stops the official clock when a penalty or face-off is called and starts it again when play resumes. The *penalty timekeeper* keeps track of the time a player serves in the penalty box. The *official scorer* records the goals scored, the names of the scorers, and the players who score *assists*—that is, passes or other plays that contribute to goals. Two *goal judges,* one behind each goal cage off the ice, carefully watch shots at the goal. They turn on the red goal light to show that a puck has entered the net and scored. The *statistician* records team and individual performances.

In 1991, the NHL introduced the use of video replay to assist in determining disputed goals. A *video goal judge* makes the final ruling on these goals. Only the referee or the video goal judge may request a video replay.

Organized hockey

Professional leagues. There is one major professional hockey league in the United States and Canada, the National Hockey League. There are also six minor professional leagues. They are the American Hockey League, the International Hockey League, the East Coast Hockey League, the Central Hockey League, the United Hockey League, and the Canadian Hockey League. Three junior leagues make up the Canadian Hockey League—

Hockey penalty signals

Signals for penalties stop play at once. If the penalty is against the defending team, the official signals a *delayed call* and stops play when the other team loses possession of the puck.

WORLD BOOK photos by Dan Miller

Holding

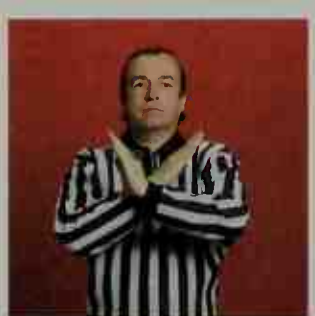
Charging

Icing the puck

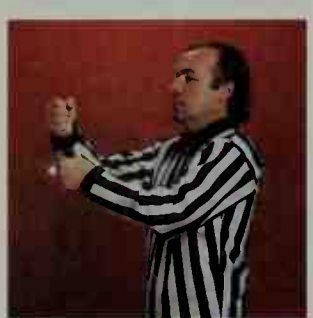
Slashing

Cross-checking

Boarding

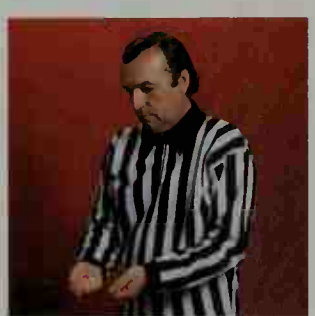


Interference



High-sticking

Tripping



Hooking

Misconduct

Delayed call of penalty

the Ontario Hockey League, the Quebec Major Junior Hockey League, and the Western Hockey League. Many minor league teams are associated with a particular NHL team to provide playing experience and training for that team's beginning players.

Each year, the NHL teams obtain new players through a system known as the *draft.* The players may come from the minor leagues, from college teams, or from professional teams in European countries. The team with the worst regular season record picks first in the draft, and the team with the best record selects last through nine rounds. No team may sign a player drafted by another team unless the player is released by the drafting team. An undrafted player can sign with any team.

The regular hockey season lasts from October to April. In the NHL, the top eight teams in each conference qualify for post-season play-offs, which may last as late as June. The finalists play for the Stanley Cup. The NHL also awards 11 individual trophies annually, including the Art Ross Trophy to the leading scorer; the Hart Memorial Trophy to the player judged most valuable to his team; the Lady Byng Trophy for sportsmanship; and the William M. Jennings Trophy to the goalie or goalies on the team that had the fewest goals scored against it.

Amateur organization. There are four main types of amateur hockey competition: (1) U.S. and Canadian competition, excluding U.S. high school, college, and women's play; (2) international competition; (3) U.S. high school and college competition; and (4) women's play. Each type of competition has its own structure and set of rules.

USA Hockey regulates U.S. amateur play. In Canada, the Canadian Hockey Association (CHA) is the controlling group. The rules of both resemble the professional rules. USA Hockey and the CHA govern local organizations, hold tournaments, and establish amateur classifications by age group. Teams in each age classification compete with one another.

International, or *world amateur,* hockey is regulated by the International Ice Hockey Federation (IIHF), which has its headquarters in Zurich, Switzerland. Amateur hockey clubs from about 30 countries belong to the IIHF. They include USA Hockey and the CHA. Players on teams registered with IIHF members are called *registered players.*

Each year, outstanding amateur teams from a number of countries compete for the world amateur championship. Until 1972, every fourth world competition was held as part of the Winter Olympics. Since 1972, the world and Olympic championships have been held separately. The IIHF establishes the rules for these contests. Most IIHF members have adopted IIHF rules.

National Hockey League Stanley Cup finals

Season	Winner	Loser	Games won-lost
1917-1918	Toronto Arenas	Vancouver Millionaires	3-2
1918-1919	No winner*		
1919-1920	Ottawa Senators	Seattle Metropolitans	3-2
1920-1921	Ottawa Senators	Vancouver Millionaires	3-2
1921-1922	Toronto St. Pats	Vancouver Millionaires	3-2
1922-1923	Ottawa Senators	Edmonton Eskimos	2-0
1923-1924	Montreal Canadiens	Calgary Tigers	2-0
1924-1925	Victoria Cougars†	Montreal Canadiens	3-1
1925-1926	Montreal Maroons	Victoria Cougars	3-1
1926-1927	Ottawa Senators	Boston Bruins	2-0
1927-1928	New York Rangers	Montreal Maroons	3-2
1928-1929	Boston Bruins	New York Rangers	2-0
1929-1930	Montreal Canadiens	Boston Bruins	2-0
1930-1931	Montreal Canadiens	Chicago Blackhawks	3-2
1931-1932	Toronto Maple Leafs	New York Rangers	3-0
1932-1933	New York Rangers	Toronto Maple Leafs	3-1
1933-1934	Chicago Blackhawks	Detroit Red Wings	3-1
1934-1935	Montreal Maroons	Toronto Maple Leafs	3-0
1935-1936	Detroit Red Wings	Toronto Maple Leafs	3-1
1936-1937	Detroit Red Wings	New York Rangers	3-2
1937-1938	Chicago Blackhawks	Toronto Maple Leafs	3-1
1938-1939	Boston Bruins	Toronto Maple Leafs	4-1
1939-1940	New York Rangers	Toronto Maple Leafs	4-2
1940-1941	Boston Bruins	Detroit Red Wings	4-0
1941-1942	Toronto Maple Leafs	Detroit Red Wings	4-3
1942-1943	Detroit Red Wings	Boston Bruins	4-0
1943-1944	Montreal Canadiens	Chicago Blackhawks	4-0
1944-1945	Toronto Maple Leafs	Detroit Red Wings	4-3
1945-1946	Montreal Canadiens	Boston Bruins	4-1
1946-1947	Toronto Maple Leafs	Montreal Canadiens	4-2
1947-1948	Toronto Maple Leafs	Detroit Red Wings	4-0
1948-1949	Toronto Maple Leafs	Detroit Red Wings	4-0
1949-1950	Detroit Red Wings	New York Rangers	4-3
1950-1951	Toronto Maple Leafs	Montreal Canadiens	4-1
1951-1952	Detroit Red Wings	Montreal Canadiens	4-0
1952-1953	Montreal Canadiens	Boston Bruins	4-1
1953-1954	Detroit Red Wings	Montreal Canadiens	4-3
1954-1955	Detroit Red Wings	Montreal Canadiens	4-3
1955-1956	Montreal Canadiens	Detroit Red Wings	4-1
1956-1957	Montreal Canadiens	Boston Bruins	4-1
1957-1958	Montreal Canadiens	Boston Bruins	4-2
1958-1959	Montreal Canadiens	Toronto Maple Leafs	4-1
1959-1960	Montreal Canadiens	Toronto Maple Leafs	4-0
1960-1961	Chicago Blackhawks	Detroit Red Wings	4-2
1961-1962	Toronto Maple Leafs	Chicago Blackhawks	4-2
1962-1963	Toronto Maple Leafs	Detroit Red Wings	4-1
1963-1964	Toronto Maple Leafs	Detroit Red Wings	4-3
1964-1965	Montreal Canadiens	Chicago Blackhawks	4-3
1965-1966	Montreal Canadiens	Detroit Red Wings	4-2
1966-1967	Toronto Maple Leafs	Montreal Canadiens	4-2
1967-1968	Montreal Canadiens	St. Louis Blues	4-0
1968-1969	Montreal Canadiens	St. Louis Blues	4-0
1969-1970	Boston Bruins	St. Louis Blues	4-0
1970-1971	Montreal Canadiens	Chicago Blackhawks	4-3
1971-1972	Boston Bruins	New York Rangers	4-2
1972-1973	Montreal Canadiens	Chicago Blackhawks	4-2
1973-1974	Philadelphia Flyers	Boston Bruins	4-2
1974-1975	Philadelphia Flyers	Buffalo Sabres	4-2
1975-1976	Montreal Canadiens	Philadelphia Flyers	4-0
1976-1977	Montreal Canadiens	Boston Bruins	4-0
1977-1978	Montreal Canadiens	Boston Bruins	4-2
1978-1979	Montreal Canadiens	New York Rangers	4-1
1979-1980	New York Islanders	Philadelphia Flyers	4-2
1980-1981	New York Islanders	Minnesota North Stars	4-1
1981-1982	New York Islanders	Vancouver Canucks	4-0
1982-1983	New York Islanders	Edmonton Oilers	4-0
1983-1984	Edmonton Oilers	New York Islanders	4-1
1984-1985	Edmonton Oilers	Philadelphia Flyers	4-1
1985-1986	Montreal Canadiens	Calgary Flames	4-1
1986-1987	Edmonton Oilers	Philadelphia Flyers	4-3
1987-1988	Edmonton Oilers	Boston Bruins	4-0
1988-1989	Calgary Flames	Montreal Canadiens	4-2
1989-1990	Edmonton Oilers	Boston Bruins	4-1
1990-1991	Pittsburgh Penguins	Minnesota North Stars	4-2
1991-1992	Pittsburgh Penguins	Chicago Blackhawks	4-0
1992-1993	Montreal Canadiens	Los Angeles Kings	4-1
1993-1994	New York Rangers	Vancouver Canucks	4-3
1994-1995	New Jersey Devils	Detroit Red Wings	4-0
1995-1996	Colorado Avalanche	Florida Panthers	4-0
1996-1997	Detroit Red Wings	Philadelphia Flyers	4-0
1997-1998	Detroit Red Wings	Washington Capitals	4-0
1998-1999	Dallas Stars	Buffalo Sabres	4-2
1999-2000	New Jersey Devils	Dallas Stars	4-2
2000-2001	Colorado Avalanche	New Jersey Devils	4-3
2001-2002	Detroit Red Wings	Carolina Hurricanes	4-1

*Play-off between Montreal Canadiens and Seattle Metropolitans not finished because of influenza epidemic in Seattle.
†Member, Pacific Coast League.

National Hockey League

Eastern Conference

Atlantic Division	Northeast Division	Southeast Division
New Jersey Devils	Boston Bruins	Atlanta Thrashers
New York Islanders	Buffalo Sabres	Carolina Hurricanes
New York Rangers	Montreal Canadiens	Florida Panthers
Philadelphia Flyers	Ottawa Senators	Tampa Bay Lightning
Pittsburgh Penguins	Toronto Maple Leafs	Washington Capitals

Western Conference

Central Division	Northwest Division	Pacific Division
Chicago Blackhawks	Calgary Flames	Anaheim Mighty Ducks
Columbus Blue Jackets	Colorado Avalanche	Dallas Stars
Detroit Red Wings	Edmonton Oilers	Los Angeles Kings
Nashville Predators	Minnesota Wild	Phoenix Coyotes
St. Louis Blues	Vancouver Canucks	San Jose Sharks

The National Collegiate Athletic Association (NCAA) sets up the rules for U.S. college hockey and holds annual college championship matches. Most high school teams in the United States follow NCAA rules. Canadian high school and college teams follow CHA rules.

Amateur hockey for women has gained increasing popularity in the United States and Canada. Women use the same rules that men use. But in most women's games, no checking is allowed and there is little body contact. In the United States, women's teams are divided into three classes. The classes are *open* (age 16 and older); *teen* (ages 13 to 15); and *junior* (ages 8 to 12).

History of hockey

Beginnings. Hockey developed in Canada. According to the CAHA, British soldiers in Kingston, Ontario, and Halifax, Nova Scotia, played the first games, about 1855. The idea for ice hockey probably came from the older game of field hockey. In field hockey, the players use curved sticks to hit a rubber ball through a goal at each end of a playing field (see Field hockey).

In the 1870's, students at McGill University in Montreal drew up the first formal ice hockey rules. The rules substituted a puck for the rubber ball and set the number of players on a team at nine. The McGill rules were widely distributed during the 1880's. Hockey teams sprang up in many parts of Canada. By 1893, the game was so popular that the governor general, Baron Stanley of Preston, donated a silver bowl to be awarded annually to Canada's champion hockey team. In 1894, a Montreal team won the first Stanley Cup match. The first U.S. hockey games were probably played in about 1895 at Yale University and Johns Hopkins University.

Professional hockey. The first professional hockey team was organized at Houghton, Michigan, in 1903. Most of the players were Canadians. Hockey's first professional league, the International Pro Hockey League, was started in 1904. It included teams from both Canada and the United States. Several other professional leagues were started soon after 1904.

The National Hockey League was formed in Montreal in 1917 from an earlier professional league, the National Hockey Association. The four original NHL teams were the Montreal Canadiens, Montreal Wanderers, Ottawa Senators, and Toronto Arenas. Six-man teams, which were first introduced in 1904, became the rule in the newly organized NHL.

In 1924, the Boston Bruins became the first U.S. team to join the NHL. A team each from Chicago, Detroit, and Pittsburgh and two teams from New York City joined in 1925 and 1926. The Pittsburgh team and one New York City team later dropped out. By 1942, the NHL consisted of the Boston Bruins, Chicago Blackhawks, Detroit Red Wings, Montreal Canadiens, New York Rangers, and Toronto Maple Leafs. This membership remained unchanged until 1967.

Famous players and All-Star teams. The early hockey stars were almost all Canadians, as are the majority of professional stars today. They included such colorful players as Newsy Lalonde, Joe Malone, Lester Patrick, and Cyclone Taylor. Hockey began to grow in popularity after U.S. teams joined the NHL. Fans of the late 1920's and early 1930's flocked to see such stars as forwards Bill Cook and Howie Morenz; defensemen King Clancy, Lionel Conacher, Ching Johnson, and Eddie Shore; and goalies Chuck Gardiner and George Hainsworth. Clancy, Cook, Gardiner, Johnson, Morenz, and Shore were among the players named to the first annual NHL hockey All-Star teams. Hockey writers and broadcasters began the tradition of naming players to a first and second All-Star team just after the 1930-1931 season.

The NHL held its first annual All-Star Game in 1947. The All-Star team for this game was selected from the first and second All-Star teams of the preceding season. It included such players as forwards Doug Bentley and his brother Max, Ted Lindsay, Maurice Richard, and Milt Schmidt; defensemen Ken Reardon and Jack Stewart; and goalies Frank Brimsek and Bill Durnan. The All-Star team met the Toronto Maple Leafs, the 1947 Stanley Cup winners. The All-Stars won the game.

Today, a team of All-Stars from North America meets a team of top NHL players from the rest of the world for the All-Star Game. Since 1947, the games have featured such forwards as Jean Beliveau, Bobby Clarke, Marcel Dionne, Phil Esposito, Bernie Geoffrion, Wayne Gretzky, Gordie Howe, Bobby Hull, Jaromir Jagr, Mario Lemieux, Mark Messier, and Stan Mikita. Defensemen have included Ray Bourque, Paul Coffey, Doug Harvey, Guy Lapointe, Bobby Orr, Pierre Pilote, and Denis Potvin. Among the All-Star team goalies have been Ken Dryden, Tony Esposito, Ed Giacomin, Glenn Hall, Dominik Hasek, Bernie Parent, Jacques Plante, Patrick Roy, and Terry Sawchuk. Since the 1985-1986 season, hockey fans have chosen the All-Star teams.

The first Hockey Hall of Fame opened in Toronto in 1961. Another hall of fame opened in Kingston, Ontario, in 1965. The U.S. Hockey Hall of Fame was established in Eveleth, Minnesota, in 1973. They all honor former players, coaches, referees, and other people who helped develop and promote the sport of hockey.

Amateur development. The IIHF was founded in 1908. The first amateur world championship was held in 1920 as part of the Olympic Games and marked the beginning of Olympic hockey competition. Canadian teams won most world and Olympic championships until the 1950's, when teams from the Soviet Union began a string of victories. The United States has won gold medals in the 1960 and 1980 Winter Olympics.

The Canadian Amateur Hockey Association (now the

Canadian Hockey Association) was founded in 1914 and began organizing Canadian amateur hockey on a national basis. The Amateur Hockey Association of the United States (now USA Hockey) was founded in 1937. By the early 1950's, it had organized United States amateur hockey nationally. The NCAA started its annual tournaments in 1948.

The World Ice Hockey Championships. Since 1924, various national teams have competed in the World Ice Hockey Championships. These championships take place annually, except during years when the Olympic Games are held. Professional hockey players may compete in the championships. But many of the best NHL players have been unable to play in them, because the championships take place while NHL teams are playing for the Stanley Cup.

Developments in the late 1900's. In 1972, a national team from the Soviet Union met a team of Canada's top professionals in an eight-game tournament. Canada won four games, lost three, and tied one.

In 1976, competition began in the Canada Cup tournament. The tournament, played every three or four years, matches national teams from European countries with teams representing the United States and Canada. The games are played in various North American arenas.

The World Hockey Association (WHA) was organized in 1971 and began its first season in 1972. After the 1978-1979 season, the WHA disbanded and four of its teams joined the NHL. These teams were the Edmonton Oilers, the New England Whalers, the Quebec Nordiques, and the Winnipeg Jets.

The NHL began an expansion program in 1967, adding new divisions and enlarging the play-off structure to allow more teams to compete. By 2000, the league had expanded to 30 teams.

In April 1992, the NHL players went on strike, the first strike in league history. The strike lasted 10 days before the players' union and the team owners reached a settlement. Another labor dispute led to the cancellation of almost half the 1994-1995 regular season before the players and owners agreed on a new contract.

Gordon Howe

Related articles in *World Book* include:

Esposito, Phil
Field hockey
Gretzky, Wayne
Howe, Gordie
Hull, Bobby
Ice skating (picture: Hockey skates)
Lemieux, Mario
Orr, Bobby
Richard, Maurice
Ringette
Stanley Cup

Outline

I. **How to play hockey**
   A. The rink
   B. Playing time
   C. The starting lineup
   D. Equipment
   E. Hockey skills
   F. Playing the game
   G. Offensive play
   H. Defensive play
   I. Violations and penalties
   J. The officials
II. **Organized hockey**
   A. Professional leagues
   B. Amateur organization
III. **History**

Questions

What are the only times that play is normally stopped during most hockey games?
Which player on a hockey team is allowed to catch the puck?
What organizations regulate U.S., Canadian, and world amateur hockey?
What are the three zones into which a hockey rink is divided?
What are the five main kinds of hockey penalties?
When was the NHL formed?
What are *stick checks? Body checks?*
When may players be substituted during a game?
What are *point men?* What is their main job?

Additional resources

Diamond, Dan, ed. *The Spirit of the Game: Exceptional Photographs from the Hockey Hall of Fame.* Triumph Bks., 1996.
Duplacey, James. *The Annotated Rules of Hockey.* Lyons & Burford, 1996.
Foley, Mike. *Fundamental Hockey.* Lerner, 1996. Younger readers.
McFarlane, Brian. *Proud Past, Bright Future: One Hundred Years of Canadian Women's Hockey.* Stoddart, 1994.
National Hockey League. *National Hockey League Official Guide and Record Book.* Triumph Bks. Published annually.

Hockney, David (1937-), has become the most internationally famous British artist of his time. Hockney is essentially a realistic painter and much of his art is autobiographical, relating to his own life and the lives of his friends. He is a versatile artist, often exploiting such techniques as photography in the composition of his paintings. Hockney became one of the first artists to explore the artistic potential of modern technology, such as fax machines, in his works. He is also noted for his photographs, drawings, and prints. Hockney has published two volumes of reminiscences, *David Hockney* (1977) and *That's the Way I See It* (1993).

Hockney was born in Bradford. He made his first impact on the art world in the early 1960's as a leader of the English pop art movement. In 1963, he moved to Los Angeles. Many of Hockney's paintings are inspired by southern California's blue skies, sunny climate, and its culture of swimming pools and pleasure-seeking lifestyles. His California paintings illustrate his characteristic use of large areas of bold color. Rebecca Jeffrey Easby

Oil painting on canvas (1967); Tate Gallery, London (Art Resource)

A Hockney painting called *A Bigger Splash* reflects the influence of the southern California lifestyle on this English artist. The large areas of bold color are typical of Hockney's style.

Hodgkin, Dorothy Crowfoot (1910-1994), a British biochemist and crystallographer, won the 1964 Nobel Prize for determining the highly complex structure of the vitamin B_{12} molecule. She used X rays to make this discovery. Knowledge of the molecular structure of vitamin B_{12} has enabled scientists to better understand how the body uses this substance to build red blood cells and prevent a disease called *pernicious anemia.*

Hodgkin devoted her career to studying the structures of complex substances through a method called *X-ray crystallographic analysis* (see **X rays** [In crystal research]). During the 1940's, she determined the molecular structures of cholesterol iodide, penicillin, and other related organic compounds. In 1969, she revealed the three-dimensional structure of insulin, a protein used to treat diabetes.

Dorothy Crowfoot was born on May 12, 1910, in Cairo, Egypt. She graduated from Oxford University in 1931 and joined the faculty of the university in 1934. She conducted most of her research at Oxford, and was widely honored for her work. Crowfoot married Thomas L. Hodgkin, a historian, in 1937. Trevor H. Levere

Hodgkin's disease is a type of cancer in which the lymph nodes become enlarged (see **Lymphatic system**). Other lymphoid tissues, such as the spleen, also may become swollen. Most victims of Hodgkin's disease are 20 to 40 years old. The disease, which strikes more men than women, may be fatal. Its cause is unknown.

Beginning in the 1960's, medical researchers discovered much about Hodgkin's disease and how to control or even conquer it. They learned that the disease (1) spreads in a fairly predictable way from one group of lymph nodes to the next; (2) takes a relatively long time to spread to other areas of the body; (3) can usually be treated successfully with radiation in early stages; and (4) can often be treated successfully with drugs in advanced stages. Hodgkin's disease resembles other diseases that also cause swelling of the lymph nodes. Physicians identify the condition by the presence in the swollen tissue of large cells called *Reed-Sternberg cells.* Most of these large cells have two nuclei. Hodgkin's disease was first described by Thomas Hodgkin, an English physician, in 1832. Carol Fabian

See also **Bone marrow transplant.**

Hoffa, James Phillip (1941-), an American labor leader, became president of the Teamsters Union in 1999. The Teamsters Union is one of the largest labor unions in the United States. Hoffa has sought to organize new members, negotiate and enforce industry contracts, and improve health and safety regulations in the workplace. He is the son of James Riddle Hoffa, who served as president of the Teamsters from 1958 to 1971.

Hoffa was born May 19, 1941, in Detroit. Because of his father's involvement with the Teamsters, he became active in the union at a young age. He received his bachelor's degree in economics from Michigan State University in 1963, and his law degree from the University of Michigan in 1966. From 1968 to 1993, Hoffa was a labor attorney in Detroit, representing the concerns of Teamsters members. From 1993 to 1998, he was administrative assistant to the president of Michigan Joint Council 43. Hoffa won the presidency of the Teamsters in a 1998 election. He was reelected in 2001. James G. Scoville

See also **Hoffa, James Riddle; Teamsters Union.**

Hoffa, *HAHF uh,* **James Riddle** (1913-1975?), an American labor leader, was international president of the Teamsters Union from 1958 to 1971. He disappeared in 1975. Police believe he may have been kidnapped and murdered. Hoffa helped increase the influence of the Teamsters, one of the strongest unions in the United States. In 1964, he signed the first national contract with trucking companies in Teamster history.

As a labor leader, Hoffa became a much-debated public figure. He was indicted by grand juries on a variety of charges, including bribery and misusing union funds. He successfully defended himself several times. But in 1964, he was convicted of jury tampering and misusing union funds.

In 1967, Hoffa began serving an eight-year prison term for the jury tampering conviction. In 1969, he was sentenced to five more years for the union funds conviction. He was released from prison in 1971 after President Richard M. Nixon reduced his sentence.

Hoffa was born on Feb. 14, 1913, in Brazil, Indiana. He joined the Teamsters in 1932 as a warehouseman. His son, James P. Hoffa, was elected president of the Teamsters in 1998. James G. Scoville

See also **Hoffa, James Phillip; Teamsters Union.**

Hoffer, *HAHF fur,* **Eric** (1902-1983), was a former longshoreman who became widely known as a political and social philosopher. His first book, *The True Believer* (1951), developed from his interest in the psychological makeup of the politically, socially, and economically disfranchised. In the book, Hoffer considered the nature and appeal of mass movements and offered psychological observations on the nature of the people who join them. He believed that the zeal that characterizes these people is bred by frustration. Their fanaticism increases when the frustration increases.

Hoffer was born on July 25, 1902, in New York City. He had little formal education. Hoffer was a migratory worker in California from 1920 to 1943. He then worked as a longshoreman. Hoffer's other works include *The Ordeal of Change* (1963) and *The Temper of Our Time* (1967). Kenneth J. Gergen

Hoffman, Dustin (1937-), is an American actor best known for his offbeat character roles in unusual and demanding motion pictures. Hoffman won Academy Awards as best actor for his performances in *Kramer vs. Kramer* (1979) and *Rain Man* (1988).

Dustin Lee Hoffman was born Aug. 8, 1937, in Los Angeles. In 1958, Hoffman moved to New York City, where he acted in several plays. He first won fame for portraying a confused college graduate in *The Graduate* (1967).

Hoffman starred as the controversial comedian Lenny Bruce in *Lenny* (1974) and appeared in the political thriller *All the President's Men* (1976). Hoffman played a man impersonating a woman in the comedy *Tootsie* (1982). Hoffman's other films include *Midnight Cowboy* (1969), *Straw Dogs* (1971), *Papillon* (1973), *Marathon Man* (1976), *Straight Time* (1978), *Hook* (1991), *Outbreak* (1995), and *Wag the Dog* (1997). Hoffman returned to the stage in 1984 to star in a highly praised revival of the American drama *Death of a Salesman* (see **Drama** [picture: Willy Loman]). Louis Giannetti

Hoffmann, *HAWF mahn,* **Ernst Theodor Amadeus,** *TAY aw DOHR AH mah DAY us* (1776-1822), was a German writer. He mingled weird and fantastic

events with situations of everyday life. His imaginative blend of romanticism and realism influenced Edgar Allan Poe and Charles Baudelaire. Some of Hoffmann's stories were collected in *Fantastic Tales* (1814-1815) and *Night Pieces* (1816-1817). Hoffmann's novels include *The Elixirs of the Devil* (1815-1816) and *Views on Life of the Tomcat Murr* (1819-1821). His *Mademoiselle de Scudéry* (1819) was a forerunner of the detective story.

Hoffmann was born in Königsberg, Germany (now Kaliningrad, Russia). He was an author, cartoonist, composer, musician, opera director, and orchestra conductor. Hoffmann's life and works inspired Jacques Offenbach's opera *The Tales of Hoffmann.* Jeffrey L. Sammons

Hofmann, *HAHF muhn,* **Hans** (1880-1966), became famous for his abstract painting. His work as an artist and teacher greatly influenced the development of abstract art in the United States, especially after World War II (1939-1945).

Hofmann was familiar with the early modern art movements, such as cubism, expressionism, and Fauvism. He used elements from them in his own varied works. Generally, his paintings are exceptionally active, with brilliant colors and swiftly moving lines, and sometimes very thick surfaces. Hofmann's advice to his students to be attentive to elements of "push and pull" in composition characterizes his work.

Hofmann was born in Weissenburg, Germany, near Nuremberg. In 1934, Hofmann opened an art school in New York City. Hofmann's drawing *Color Intervals at Provincetown* is reproduced in the **Drawing** article. Dore Ashton

Hofmannsthal, *HOHF mahns tahl,* **Hugo von** (1874-1929), an Austrian poet and playwright, is best known for *librettos* (texts) for the operas of German composer Richard Strauss. Hofmannsthal and Strauss began a successful collaboration with *Elektra,* first staged in 1909. They continued with *Der Rosenkavalier* (1911), *Ariadne auf Naxos* (1912), *The Woman Without a Shadow* (1919), *The Egyptian Helen* (1928), and *Arabella,* produced in 1933 after Hofmannsthal died.

Hofmannsthal was born and educated in Vienna. As a young man, he created a literary sensation there with a series of symbolic verse dramas. His best-known play is *Everyman* (1911), an adaptation of an English medieval morality play. His poetry is filled with symbolism and is deeply melancholy. Walther L. Hahn

See also **Strauss, Richard.**

Hog is a farm animal raised throughout the world. These animals provide pork, which is eaten as pork chops, ham, bacon, and sausage. The fat, skin, hair, glands, and other parts of hogs are used to make a variety of products. Such products include lard, leather, brushes, soap, fertilizer, glue, and medicines.

Both young and adult hogs are also called *pigs* or *swine.* Young hogs are almost always called *pigs.* Farmers who raise hogs are called *pork producers.* Hogs rank among the most intelligent of the *domesticated* (tamed) animals. Some people consider them dirty, yet hogs keep themselves cleaner than most other farm animals do. However, hogs will often *wallow* (roll about) in mud to cool themselves during warm periods.

About 1 billion hogs live on farms throughout the world. Approximately half of these hogs are raised in China, the world's leading hog-producing country. Hogs rank with cattle, poultry, and dairy products as an important source of the world's farm income.

Wendy Neefus, Animals Animals

Hogs provide a major source of income for many of the world's farmers. This photo shows a Yorkshire sow nursing her pigs. Young pigs reach full growth at about 1 $\frac{1}{2}$ to 2 years of age.

LaVern Weller & Sons (WORLD BOOK photo)

Durocs are a popular breed of hog because they produce large litters and gain weight rapidly.

Selective breeding, better housing, and more nutritious feeds have resulted in improvements in hogs. Hogs today grow faster on less feed and produce more lean meat and less fat than did hogs that were raised in the past.

One of the main ingredients in hog feed is corn. Hogs eat about 20 percent of the corn that is grown in the

Hog terms

Barrow is a male hog whose reproductive organs have been removed by an operation.
Boar is a male hog of any age.
Farrow means to give birth to pigs.
Gilt is a female hog usually less than 1 year old that has not given birth to pigs.
Herd is a group of hogs.
Litter is the group of pigs a sow gives birth to at one time.
Pig is a young hog. The term is sometimes used for a hog of any age.
Pork is the flesh, or meat, of hogs.
Shote, or **shoat,** is a pig about 8 weeks old that has been *weaned* (taken off its mother's milk).
Sow is an adult female hog.
Swine is another name for hogs.

United States. European farmers commonly feed barley to their hogs. In countries with large dairy industries, such as Denmark, much skimmed milk is available for feeding hogs.

Kinds of hogs

There are many kinds of hogs raised around the world. Because hogs have a short reproduction cycle, new breeds can be developed over a relatively short period of time. Often, such breeds of hogs reflect the climate and production methods of the region in which they are raised. In Europe, for example, each country has developed its own breeds of hogs. In North America, regional differences among the various hog breeds are slight.

Farmers in many countries raise chiefly *crossbred* hogs. Crossbred hogs are produced by mating parents of different breeds. Crossbreds, also called *hybrids,* are more active at birth and grow more rapidly than purebreds. They also have higher reproduction rates than purebred hogs.

Hogs raised in the United States are classified as *meat-type* hogs. Meat-type hogs produce more lean meat in proportion to fat. Pork from such hogs is low in fat and provides an excellent source of high-quality protein.

United States breeds. The eight commonly raised breeds of hogs in the United States are the American Landrace, Berkshire, Chester White, Duroc, Hampshire, Poland China, Spotted Swine, and Yorkshire. Farmers in the United States developed all these breeds except the Berkshire and Yorkshire, which were imported from

Garrett Beebe (WORLD BOOK photo)

Berkshires provide meat with little excess fat.

Hampshire Swine Registry

The Hampshire was developed in the United States.

American Landrace Association

The American Landrace is a long-bodied hog.

John W. Weber & Family (WORLD BOOK photo)

Spotted Swine may be mostly black or mostly white.

Emil Fray

Poland Chinas are often used for crossbreeding.

Lyle Bidner & Family (WORLD BOOK photo)

Chester Whites must have shade to avoid sunburn.

Important breeds of hogs

Breed	Place and date of origin	Identifying features
American Landrace	Indiana, 1930's	White; drooping ears; long body
Berkshire	England, 1700's	Black with white markings; erect ears; short snout
Chester White	Pennsylvania, early 1800's	White; drooping ears
Danish Landrace	Denmark, late 1800's	White; drooping ears
Duroc	New York, early 1800's	Red; drooping ears
Hampshire	Kentucky, early 1800's	Black with white band around shoulders and front legs
Pietrain	Belgium, early 1900's	Dirty white with black or reddish spots; semidrooping ears
Poland China	Ohio, late 1800's	Black with white markings; drooping ears
Spotted Swine	Ohio and Indiana, late 1800's	Black and white spotted
Yorkshire	England, early 1800's	White; erect ears

the United Kingdom in the 1800's. The American Landrace breed includes hogs bred from Landrace stock from such countries as Denmark, Germany, Sweden, and the United Kingdom. No one breed is greatly superior in its ability to produce meat or to grow swiftly.

Other breeds. Common breeds of hogs in Europe include the Large White and the Landrace. Most European countries have their own Landrace breed. All such hogs are white and have droopy ears. The Large White is related to the Yorkshire breed in the United States. Pietrain is a muscular breed developed in Belgium, Luxembourg, and the Netherlands. There are about 40 breeds of hogs raised in China.

Wild hogs are strong, fierce animals that live in forests and jungles in many parts of the world. They include the babirusa of Indonesia, the wart hog of Africa, and the wild boar that lives in some parts of Europe, Asia, and Africa. *Razorbacks,* wild hogs with sharp, narrow backs, live in the southeastern United States and in the West Indies. They are descended from tame hogs that escaped from farms and became wild again. *Peccaries* are wild, piglike animals that live in some parts of North and South America. They are not true hogs. See Babirusa; Boar, Wild; Peccary; Wart hog.

How we use hogs

Food. We eat the meat of hogs as pork chops, spareribs, loin roasts, ham, bacon, and sausage. Popular sausages made from pork include wieners, bologna, bratwurst, mettwurst, braunschweiger, and salami. Some hog meat, such as pig's feet and knuckles, is pickled. *Chitterlings* (hog intestines) and fried pig skin are popular foods in some regions of the United States. People also eat such hog parts as the stomach, kidneys, liver, ears, brain, snout, jowls, lips, tongue, and throat. Lard used for cooking is made from hog fat. Some religions, such as Islam and Judaism, forbid their followers to eat pork.

Other uses. Tanneries process the skins of hogs into leather used for such products as belts, gloves, jackets, and shoes. The hair of the hog provides bristles for brushes. It is also used to stuff mattresses and baseball gloves. Hog blood is used to produce animal feeds, fertilizer, and medicines. Drug firms make insulin, ACTH, and other medicines from hog glands. Surgeons use valves from the hearts of hogs to replace defective heart valves in humans. People use specially prepared hog skin to treat burns. Hog fat is made into lard, soap, candles, salves, shaving cream, explosives, and lubricating oils. The bones of the hog are ground for glue, fertilizer, and animal feeds.

The bodies of hogs

The hog has a stout, strong body covered with coarse, bristly hair. Its head and short, thick neck extend in a straight line from the body. The head ends in a snout. A hog's thick skin has no sweat glands to serve as a cooling system. Hogs like to wallow in mud because it helps them keep cool. Hogs have small eyes and poor eyesight. But a keen sense of smell helps them find food. They have short tails that are usually curled. Hogs grunt and, when hurt or excited, squeal.

Size. Pigs weigh about 2 $\frac{1}{2}$ pounds (1.1 kilograms) at birth, and usually double their weight in the first week. When fully grown, boars may weigh more than 500 pounds (230 kilograms) and sows more than 450 pounds (200 kilograms). The average adult boar weighs from 350 to 500 pounds (160 to 230 kilograms) and the average adult sow from 300 to 450 pounds (140 to 200 kilograms). Most hogs are sold when they are 6 to 7 months old and weigh 220 to 265 pounds (100 to 120 kilograms). Hogs kept longer are usually used for breeding.

Snout. The hog's snout has a broad, leathery pad that includes the nostrils. The snout is very sensitive to touch. Hogs raised outdoors often use their snouts to *root,* or dig, for vegetable roots, a favorite food.

Teeth. Hogs have from 34 to 44 teeth, depending on the species. Eight of these are *canine teeth* (pointed teeth) that often develop into sharp tusks, particularly in adult males. The tusks serve as tools for digging and as weapons. Farmers may clip tusks off mature boars be-

Leading hog-raising states

Figures are for December 1, 2000.
Source: U.S. Department of Agriculture

© Andrew Sacks

A hog farm generally keeps large numbers of hogs in clean, indoor environments. Many hogs spend their entire lives indoors.

cause they can cause injury. A hog protects itself by running away. But if cornered, the hog may charge and bite.

Feet. The hog has four toes on each foot. Each toe ends in a hoof. The two middle hoofs are divided on all hogs except the Mule-Foot breed. Mule-Foot hogs have a solid, or single-toed, hoof in the middle of each foot. The two other toes on each foot do not touch the ground when the hog stands.

Life history. Hogs reproduce rapidly and can mate when about 8 months old. Sows carry their young about 114 days before *farrowing* (giving birth). Sows usually give birth to 9 to 15 pigs at a time, but the number may be 27 or more. Hogs reach full growth at 1 $\frac{1}{2}$ to 2 years of age and can live from 9 to 15 years. But most hogs are marketed when they are 6 to 7 months old.

Raising hogs

Feeding. Farmers provide hogs with well-balanced diets. Carbohydrates from corn and such grains as sorghum, barley, wheat, rye, and oats provide energy. Meals made from soybeans, linseed, cottonseed, peanuts, fish and meat scraps, skim milk, and *tankage* supply protein. Tankage is a feed made from the bones, tendons, and other parts of animals.

Farmers usually feed hogs complete diets, including vitamins and minerals. Diets contain everything hogs need to grow rapidly and efficiently.

Shelter. Many hogs spend their entire lives indoors. Their housing keeps the hogs comfortable and clean. These buildings may be partially open so that fresh air can come inside. Buildings in cooler climates may be completely enclosed and have mechanical systems that provide fresh air and control the temperature. Farmers that raise hogs outdoors keep the hogs in pastures or dirt lots. Such lots feature several small hog houses. Even if farmers choose to raise their hogs outdoors, most young hogs spend their first few months inside. Farmers move them to open lots when they are older.

Diseases. The most common diseases that attack hogs include respiratory infections, flu, and digestive disorders that cause diarrhea. *Mange* is a skin disease caused by tiny organisms called *mites* that burrow into the hog's skin. Hogs also may become infested with lice. Farmers kill mites and lice by spraying hogs with insecticides. Pork infested with *trichina worms* can cause the disease *trichinosis* in people who eat the pork. Proper cooking of pork kills trichina worms. Hogs infested with trichina worms are rare.

Farrowing. A few days before a sow farrows, the farmer washes it and places it in a clean pen. The farmer must take special care to prevent the sow from crushing its young when it lies down. Most pork producers use farrowing stalls that confine the sow to a small space, but enable the pigs to move about. Farmers usually provide the pigs with heated sleeping areas. In addition to keeping them warm, the heat attracts the pigs and keeps them out of the sow's way.

Sows usually nurse their pigs for 3 to 5 weeks. After the pigs are *weaned* (taken off their mother's milk), they are fed a diet rich in protein. During this period, pigs are kept in houses called *nurseries*.

Marketing hogs. In the past, pigs were farrowed only during seasons with mild temperatures, generally spring and fall, and then marketed six to seven months later. Modern production methods enable pork producers to farrow and market pigs throughout the year. This practice provides a consistent supply of pork products to consumers and makes better use of production facilities. Most pork producers sell their hogs directly to meat-processing plants.

History

Wild boars roamed throughout Europe and other parts of the world as long as 6 million years ago. Scientists believe people began taming hogs about 8,000 years ago, during the Stone Age. Explorers and colonists from Spain, England, and other countries brought hogs to North and South America in the early 1500's.

Until the mid-1900's, farmers commonly raised hogs for two basic purposes: the production of meat and the production of lard. Hogs raised for lard had more fat in proportion to lean meat. Meat-packing plants made hog fat into lard that was used for cooking and other purposes. Shortenings made from vegetable oils largely replaced lard in the 1950's. In addition, petroleum products replaced lard as a lubricant and in the manufacture of soap. Farmers then began raising more hogs for meat.

Beginning in the 1970's, the number of farms raising hogs began to decline. Many countries now raise most of their hogs on large, specialized farms rather than on small family farms.

William T. Ahlschwede

Scientific classification. Hogs belong to the pig family, Suidae. The scientific name for the European wild hog, from which domestic hogs are largely descended, is *Sus scrofa*.

Related articles in *World Book* include:

Babirusa	Foot-and-mouth disease	Peccary
Bacon	Ham	Pork
Boar, Wild	Lard	Sausage
Brucellosis	Meat	Trichina
Farm and farming	Meat packing	Wart hog
Fat		

Hogan is a house of the Navajo Indians of the American Southwest. Hogans may be round, six-sided, or eight-sided, and they may be constructed in many different ways. Most hogans are built of logs and earth, but some have stone walls. The most common hogan is probably a rounded or eight-sided structure about 20 feet (6 meters) in diameter, with stacked log walls and a roof made of logs and dirt piled in a mound. Hogans have a single door, which always faces east.

Michael D. Green

Hogan, Ben (1912-1997), an American golfer, was one of the greatest players in the history of the sport. Hogan won more than 60 tournaments, including the United States Open four times, the Professional Golfers' Association (PGA) tournament twice, the Masters twice, and the British Open once.

In 1949, a bus struck the car Hogan was driving. The collision fractured his left collarbone, left ankle, pelvis, and a rib. Hogan barely survived the injuries. Doctors feared he might not be able to walk again, much less play golf. Yet, just 17 months after the accident, Hogan won the 1950 U.S. Open. He played the tournament with his legs wrapped in bandages.

Hogan was born in Dublin, Texas. His full name was William Benjamin Hogan. He became famous for his determination to perfect his swing through hours of practice. Hogan was one of the smallest golf champions, weighing only 135 pounds (61.2 kilograms).

Marino A. Parascenzo

See also **Golf** (picture; tables).

Hogarth, *HOH gahrth,* **William** (1697-1764), was the leading English satirical painter of the 1700's. He was also a noted engraver and art critic. Hogarth became best known for paintings and engravings that humorously commented on manners and morals of his time.

Hogarth created several series of paintings that told a story through a number of related scenes. These series include the eight paintings that make up *A Rake's Progress* (early 1730's) and the six paintings in *Marriage à la Mode* (1743). Hogarth made engravings of both series. The sale of these engravings made him wealthy.

Hogarth was born in London. He was trained to be a silversmith but decided to devote himself to fine art. Hogarth carefully studied the masters of Flemish, French, and Italian painting, but he was also inspired by the life he observed around him.

Hogarth first gained success as a painter with a picture based on *The Beggar's Opera* (1728), a musical play about criminals and corrupt public officials in London. This painting launched him on a career as a painter of comic scenes of everyday life. Hogarth also painted many realistic, often unflattering, portraits that reflected the artist's strong sense of color and his powers of observation.

Hogarth was a controversial and outspoken art critic whose opinions angered many of his fellow artists. He wrote one book, *The Analysis of Beauty* (1753), which combined practical advice on painting with his own theories of art.

Douglas K. S. Hyland

See also **Fielding, Henry** (picture).

Hogg, Helen Sawyer (1905-1993), an American-born astronomer, became known for her research on *variable stars.* She discovered more than 250 of these stars, whose light varies in brightness. Hogg chiefly studied variable stars in *globular star clusters,* which are ball-like groups of stars in the Milky Way Galaxy. Her work included measuring the *period* of many of these stars. A variable star's period is the time its light takes to change from bright to dim and back to bright. This information, in certain cases, helps astronomers determine the distance of the star from the earth.

Helen Battles Sawyer was born in Lowell, Massachusetts. She married Frank S. Hogg, a Canadian astronomer, in 1930. She received a Ph.D. degree in astronomy

Oil painting on canvas (1743); the National Gallery, London

A Hogarth painting called *Signing the Marriage Contract* is part of a series of six paintings called *Marriage à la Mode.* The series provides a satirical commentary on upper-class marriage customs in England during Hogarth's time. The fathers of the bride and groom, seated at the right, arrange the bride's dowry with two lawyers. At the left, another lawyer explains financial details of the contract to the bride. The bored groom is at the far left.

from Radcliffe College in 1931. The first edition of her major work, *Catalogue of Variable Stars in Globular Clusters,* was published in 1939. In 1935, Hogg joined the faculty of the University of Toronto, where she conducted most of her research. In 1957, Hogg became the first woman to serve as president of the Royal Astronomical Society of Canada. Peggy Aldrich Kidwell

Hogrogian, *HUH GROHG ih uhn,* **Nonny** (1932-), is an illustrator and designer of children's books. She won the Caldecott Medal in 1966 for her work in *Always Room for One More* by Sorche Nic Leodhas, and in 1972 for *One Fine Day,* which she also wrote. Hogrogian illustrated *The Contest,* a 1976 Caldecott Honor book, which she adapted from a folk tale. She has illustrated more than 30 picture books in a variety of styles. Many of Hogrogian's illustrations are *woodcuts* (pictures made from engraved wooden blocks). She illustrated *Gaelic Ghosts* (1964), also by Nic Leodhas; *Poems of Stephen Crane* (1964); and *The Fearsome Inn* (1967) by Isaac Bashevis Singer. Hogrogian was born in New York City. Virginia L. Wolf

Hogweed. See Ragweed.

Hohenstaufen, *HOH uhn SHTOW fuhn,* was the name of a princely family of medieval Germany that held the imperial throne from 1138 to 1254. The family took its name from the ancestral castle built at Staufen in southern Germany in the 1000's.

Frederick of Hohenstaufen received the duchy of Swabia from Emperor Henry IV as a reward for loyal service. He married Henry's daughter Agnes. Frederick's son, also called Frederick, claimed the hereditary right to the crown. But in 1125 the German princes reaffirmed their right of free election.

In 1138, a member of the Hohenstaufen family secured the German throne as Conrad III. Frederick I (Barbarossa), Henry VI, and Frederick II were also Hohenstaufen rulers. James J. Sheehan

See also **Frederick II** (Holy Roman emperor); **Germany** (The Holy Roman Empire); **Henry VI** (of Germany).

Hohenzollern, *HOH uhn ZAHL uhrn,* is the name of the famous royal family that ruled Brandenburg, Prussia, and the German Empire. The name came from the family castle of Zollern in Swabia.

The Hohenzollerns started as counts. They became *electors* (rulers) of Brandenburg in 1417. In 1618, they began to add parts of Prussia to their holdings. Prussia was recognized as a kingdom in 1701 under Frederick I. After Germany was united in 1871, the Hohenzollerns were both kings of Prussia and German emperors. They established efficient governments and strong armies. The family lost its throne in World War I.

The best-known Hohenzollern rulers included Frederick William, the Great Elector; Frederick William I; Frederick II; and Wilhelm II. Wilhelm II was the German Kaiser during World War I. Charles W. Ingrao

Related articles in *World Book* include:

Franco-Prussian War
Frederick II (of Prussia)
Frederick III (of Prussia)
Frederick William
Germany (History)
Teutonic Knights
Wilhelm

Hohokam. See Pima Indians.

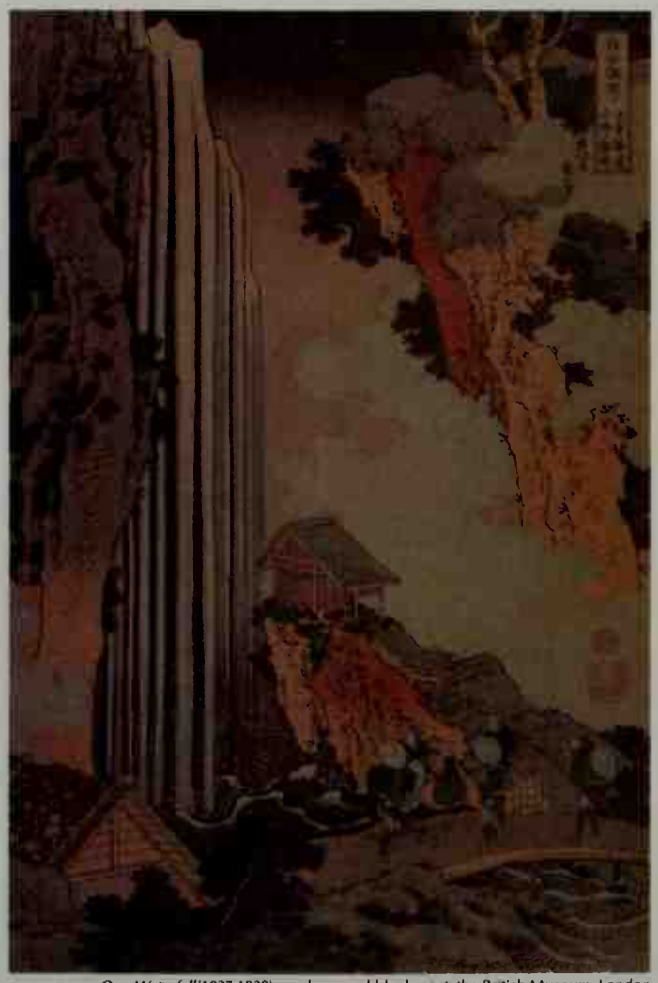
Hohokam Pima National Monument, *huh HOH kuhm PEE muh,* is in south-central Arizona. It includes the remains of Hohokam Indian artwork, homes, irrigation canals, and tools that date from about 300 B.C. to A.D. 1200. Pima Indians, who believe the Hohokam were their ancestors, live in the area today. The United States government established the site as a national monument in 1972. The ruins are not on public display. For the area of the Hohokam Pima National Monument, see **National Park System** (table: National monuments).

Critically reviewed by the National Park Service

Hokusai, *HOH ku SY or HAW koo SY* (1760–1849), was a Japanese painter and designer of wood-block prints. Hokusai created an enormous number of paintings and prints using many styles and subjects, but he is best known for his landscape prints. Hokusai ranks with Hiroshige as the most famous Japanese landscape artist of the 1800's. Hokusai created several series of prints from 1823 to 1835. One famous set of prints consists of scenes of Mount Fuji as seen from various points, both near and far.

Katsushika Hokusai was born in Edo (now Tokyo). He studied under Katsukawa Shunshao, a leading Japanese artist. Hokusai had a long career, but he produced most of his important work after the age of 60. Although his works were popular, Hokusai spent much of his life in poverty.

In the 1850's, after his death, some of Hokusai's prints were displayed in the West. In the late 1800's, they influ-



Ono Waterfall (1827-1830), a color wood-block print, the British Museum, London

A Hokusai print shows the artist's skill in portraying landscapes. Hokusai's decorative style emphasizes the bold use of line. He generally limited his colors to blue, brown, and green.

enced some Western artists, including James A. M. Whistler, Paul Gauguin, Vincent van Gogh, and Henri de Toulouse-Lautrec. Robert A. Rorex

See also Animal (picture: People and animals).

Holbein, *HOHL byn,* **Hans, the Elder** (1465?–1534?), was a painter who worked in southern Germany and the region of Alsace in what is now France. Holbein was born in Augsburg, Germany, and maintained a workshop in the city during the late 1490's and early 1500's. His two sons, Ambrosius and Hans the Younger, received their first training as painters there.

Holbein's paintings include altarpieces for churches and convents. His best works, however, were his drawings, particularly portraits of his two sons done in a technique called *silverpoint.* Jane Campbell Hutchison

Holbein, *HOHL byn,* **Hans, the Younger** (1497?–1543), ranks among the world's greatest portrait painters. Holbein was born in Augsburg, Germany. He received his earliest training there from his father and uncles, but moved to Switzerland when he was about 18 years old. Holbein worked in Basel, where he painted the portraits of many important people, notably the Dutch scholar Desiderius Erasmus. During this time, Holbein also designed a series of woodcuts called *The Dance of Death* (1523-1526). He also painted several important religious works during this period, such as *The Dead Christ* (1521).

Holbein spent the winter of 1526-1527 in London as the house guest of Erasmus's friend Saint Thomas More. Holbein painted and drew portraits of the More family and their friends. He settled permanently in England in 1532 and soon became court painter to King Henry VIII. His duties included designing jewelry and painting portraits of the king and other members of the royal court and household. Many of these portraits have a flat, patterned appearance, perhaps to emphasize that they represent royalty. Jane Campbell Hutchison

Kunsthistorisches Museum, Vienna

A portrait by Hans Holbein the Younger shows how the artist realistically captured the character of his subjects. Holbein painted this picture of an unknown young merchant in 1541.

Related articles in *World Book.* Articles with Holbein portraits include:

Clothing (Puffs of fabric)
Edward VI
Erasmus, Desiderius
Henry VIII
More, Saint Thomas
Renaissance (picture: Desiderius Erasmus)

Holberg, *HAHL barg,* **Ludvig,** *LOOTH vee* (1684-1754), was Scandinavia's first important playwright. Holberg, who wrote in Danish, modeled his comedies on the works of the Roman playwright Plautus and the French playwright Molière. Like Plautus and Molière, Holberg used typical comic characters such as a talkative barber, an amateur politician, and a bragging soldier. He relied heavily on mistaken identities to add excitement to his plots. Holberg's intention was to educate his audience by amusing them. In his comedies, foolish people tend to become sensible. His best-known comedies include *The Political Tinker* (1722), *Jeppe of the Hill* (1722), and *Erasmus Montanus* (1731). Holberg also wrote *Peder Paars* (1719-1720), a satirical poem; and *Niels Klim* (1741), a prose satirical account of an imaginary underground journey. His *History of the Danish Kingdoms* (1732-1735) was the first cultural history of Denmark written in Danish.

Holberg was born in Bergen, Norway. He taught at the University of Copenhagen. Niels Ingwersen

Holding company is any company which holds a majority or a large enough minority of the stock in another corporation to control its policies. The holding company may control the appointment of officers and may dictate business policies. Corporations controlled by holding companies are called *subsidiary* companies.

Corporation A might buy controlling interest in both Corporations 1 and 2. Corporation B might similarly buy control of Corporations 3 and 4. Corporations A and B have become holding companies, and Corporations 1, 2, 3, and 4 have become subsidiary companies. A third large corporation, C, might buy control of both Corporations A and B. This process, known as *pyramiding,* has created financial empires, especially in public utilities, banking, and manufacturing. Robert B. Carson

See also Corporation; Antitrust laws.

Holiday is any day on which people lay aside their ordinary duties and cares. The word comes from the Anglo-Saxon *halig daeg,* or *holy day.* At first, holidays honored some sacred event or holy person. People in the United Kingdom and other countries speak of holidays as Americans speak of vacations. For a discussion of religious holidays, see Feasts and festivals.

In the United States, Sunday is the only holiday recognized by common law. Congress has at various times set aside special holidays, such as V-E and V-J days to celebrate the end of fighting in World War II (1939-1945). However, there are no national holidays as such. Each state has the authority to specify the holidays it will observe. The governor proclaims the holidays for the state. The president and Congress designate the holidays to

be observed in the District of Columbia, and by federal employees throughout the country. Congress has declared the following as legal federal holidays: New Year's Day (January 1); Martin Luther King, Jr.'s, Birthday (January 15, but observed on the third Monday in January); Washington's Birthday (February 22, but observed on the third Monday in February); Memorial Day (the last Monday in May); Independence Day (July 4); Labor Day (the first Monday in September); Columbus Day (the second Monday in October); Veterans Day (November 11); Thanksgiving Day (the fourth Thursday in November); and Christmas Day (December 25).

Most states observe the last Monday in May as Memorial Day, sometimes called Decoration Day. Most Southern States also celebrate Confederate Memorial Day in April, May, or June. Several Southern States celebrate the birthdays of Jefferson Davis (June 3) and Robert E. Lee (January 19). Abraham Lincoln's birthday is a legal holiday in about 30 states. Most of these states celebrate it on February 12, but a few celebrate it on the first or third Monday of February. Some people in New England celebrate Forefathers' Day (December 21), and Maine and Massachusetts celebrate Patriots' Day (third Monday in April). In the year of a presidential election, Election Day (first Tuesday after the first Monday in November) is a legal holiday in many states. Some holidays are observed by one state only. For example, a state may observe a holiday to commemorate its admission into the Union.

Banks and schools usually close on a legal holiday. When such a holiday falls on Sunday, the following Monday is usually observed. Schools and organizations often observe days known as traditional holidays, although schools and businesses do not close then. These days are Valentine's Day (February 14); St. Patrick's Day (March 17); and Halloween (October 31). In some states, Arbor Day, Bird Day, and Flag Day are school holidays. Child Health Day (the first Monday in October) is widely observed in schools. Many schools and some businesses close on Good Friday.

In Canada, public holidays include New Year's Day; Good Friday; Easter Monday; Queen's Birthday (also called Victoria Day, the Monday before May 25); Canada Day (July 1); Labour Day (the first Monday in September); Thanksgiving Day (the second Monday of October); Remembrance Day (November 11); and Christmas (December 25).

In other countries. Every country has its own special holidays. In Ireland, Saint Patrick's Day (March 17) is a legal holiday. Some outstanding French holidays include Bastille Day (July 14); Joan of Arc's Day (second Sunday of May); and Saint Catherine's Day (November 25). In the United Kingdom, Boxing Day (the first workday after Christmas) and May Day (May 1) are legal holidays.

Some holidays mark special events in the development of a country. Examples of these holidays include Greece's Independence Day (March 25); Italy's Liberation Day (April 25); Japan's Constitution Day (May 3); India's Independence Day (August 15); and Mexico's Independence Days (September 15 and 16).

Sharron G. Uhler

Related articles in *World Book.* See the *Annual events* section of each state and province article, the *People* section of the country articles, and the articles on the months of the year. See Feasts and festivals with its list of *Related articles.* See also:

April Fools' Day
Arbor Day
Armed Forces Day
Bastille Day
Bill of Rights Day
Boxing Day
Canada Day
Christmas
Cinco de Mayo
Citizenship Day
Columbus Day
Easter
Election Day
Fair
Father's Day
Flag Day
Freedom Day, National
Ground-Hog Day
Halloween
Independence Day
Kwanzaa
Labor Day
Law Day U.S.A.
Lincoln's Birthday
Mardi Gras
Martin Luther King, Jr., Day
May Day
Memorial Day
Mother's Day
New Year's Day
Presidents' Day
Remembrance Day
Saint Patrick's Day
Thanksgiving Day
V-E Day
V-J Day
Valentine's Day
Veterans Day
Victoria Day
Walpurgis Night
Washington's Birthday

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Holiday, Billie (1915-1959), won recognition as the most moving jazz singer of her day. She was admired for the uniquely bittersweet quality of her voice, and for phrasing that had much in common with the solos of the great improvising jazz musicians. Although Holiday was often described as a blues singer, she was principally an interpreter of popular songs.

Billie Holiday was born on April 7, 1915, in Baltimore. Her real name was Eleanora Fagan. She was raised by her mother in a black ghetto. Holiday described the hardships of her childhood in *Lady Sings the Blues* (1956), an inaccurate but interesting autobiography. She made her first recordings with Benny Goodman in 1933. Her most distinctive work was recorded between 1936 and 1944. In these recordings, she was often accompanied by such great jazz musicians as Count Basie, Roy Eldridge, Teddy Wilson, and Lester Young. After 1950, drug addiction increasingly affected Holiday's health and career.

Wide World

Billie Holiday

Frank Tirro

Holinshed's, *HAHL ihnz HEHDZ,* **Chronicles** is a book of English, Scottish, and Irish history and geography that was first published in 1578. *Holinshed's Chronicles* is also called the *Chronicles of England, Scotland, and Ire-*

land. The English playwright William Shakespeare used it as source material for his tragedies *Macbeth* and *King Lear,* and for most of his history plays.

The *Chronicles* is named for Raphael Holinshed, an English historian. Reginald Wolfe, a London printer, began the book. Holinshed worked with him on it until Wolfe's death in 1573. Holinshed then completed the *Chronicles* with the help of several other writers. He probably died in 1580. A revised version was published in 1587. For political reasons, the government of Queen Elizabeth I ordered the removal of certain parts from each version. Albert Wertheim

See also Shakespeare, William (picture: A belief in witches).

Holistic medicine, *hoh LIHS tihk,* also spelled *wholistic medicine,* is an approach to health care based on the observation that many factors affect a person's health. Such factors include genetics, nutrition, physical activity, stress, family relationships, medical care, living and working conditions, and the environment. But any single factor might be the most important one for a particular person. The term *holistic medicine* comes from the Greek word *holos,* which means *whole.*

The emphasis of holistic medicine differs from that of traditional medicine. Traditional medicine focuses chiefly on the treatment of disease. Holistic medicine emphasizes the prevention and treatment of disease. In addition, some of its methods of diagnosis and treatment are not usually used in traditional medical practice. For example, physicians who practice holistic medicine use many treatments in addition to drugs and surgery. These methods include acupuncture, herbs, homeopathy, hypnosis, and relaxation therapies. Holistic physicians try to reduce the excessive use of drugs.

Many physicians, psychologists, and other health care professionals practice holistic medicine. Holistic practitioners stress the responsibility of the patient in achieving and maintaining the best possible health. They help patients establish good health habits, and they emphasize the importance of a physical environment that is free of toxic exposure. They also may teach patients various methods of medical self-care. For example, a patient might learn to control a normally involuntary body process, such as the rate of the heartbeat, by means of relaxation techniques, meditation, or *biofeedback* (see Biofeedback).

The idea of a holistic approach to health is as old as medicine itself. Good medical practice has always included elements of holistic medicine. After the early 1970's, holistic medicine gained increasing popularity in many countries. Its popularity grew because many people realized that the most common noninfectious diseases, including cancer and heart disease, were related to specific lifestyles and personal habits, such as smoking and diet. Kenneth R. Pelletier

See also Herbal medicine.

Holland. See Netherlands.

Holland (pop. 35,048) is a city in western Michigan that was named for the homeland of its Dutch settlers. Many residents are of Dutch descent. During its weeklong Tulip Festival, held every May, the city takes on the appearance of a village in the Netherlands, also called Holland. Thousands of tulips bloom along the streets. Many of the people dress in traditional Dutch costumes for the festival's parades and ceremonial street washing.

Holland lies at the head of Lake Macatawa, about 6 miles (10 kilometers) east of the point where the lake empties into Lake Michigan (see Michigan [political map]). Holland's industries produce boats, drugs, food products, home and office furniture, and Dutch wooden shoes. Hope College is located in Holland.

Windmill Island is a city park that features the only authentic, operating Dutch windmill in the United States. The windmill was shipped in pieces from the Netherlands and reconstructed in the city in 1965.

A group of Dutch settlers who had fled from their homeland because of economic hardship and religious persecution founded Holland in 1847. Much of the city was destroyed by fire in 1871. During the early 1900's, Holland served as an important lake port, which shipped fruits and vegetables. The city has a council-manager form of government. Peter Gavrilovich

Holland, John Philip (1841-1914), an Irish American inventor, was mainly responsible for the development of the submarine. His vessel, the *Holland,* built in 1898, proved that the submarine was practical. It provided the model for later submarines.

Holland was born in County Clare, Ireland. He began work on the idea of a submarine while teaching school in Ireland from 1858 to 1872. By 1870, he had completed the first plans for his invention. In 1873, Holland came to the United States. He settled in Paterson, New Jersey, and taught school there. He submitted his submarine plans to the U.S. Navy in 1875, but they were rejected. But the Fenian Society, a group of Irish patriots in the United States who hoped to destroy England's naval power, became interested. They supported Holland's experiments and gave him money to build two submarines. His first boat was tested with mixed results in the Passaic River in 1878. His second boat, the *Fenian Ram,* was launched in 1881. Its success established many basic features of submarines.

In 1888, the U.S. Navy asked Holland to submit submarine plans. Seven years later, it awarded him a contract to build a ship. But this vessel failed, largely because the Navy forced Holland to drop many of his ideas. To prove that his ideas were correct, Holland privately built the *Holland* and launched it successfully in 1898. In 1900, the Navy bought the *Holland* and asked the inventor to build several more ships like it. Holland's firm, the Electric Boat Company (now the Electric Boat Division of General Dynamics Corporation), has continued to build most U.S. Navy submarines. It has also built many submarines for other countries. Holland resigned from the Electric Boat Company in 1904 and attempted to establish a new firm. But legal complications blocked the undertaking, and he died in obscurity. Jack Sweetman

See also Submarine (Early submarines).

Holland Tunnel. See Hudson River tunnels.

Holly is the common name for a group of shrubs and small trees. The two best-known hollies, the *American holly* and the *English holly,* are evergreen trees. These two hollies have glossy green leaves and red berries that are used to make attractive Christmas wreaths. In the past, holly was used in houses and churches at Christmastime, and was called *holy tree.* The word *holly* may have come from this name.

There are about 300 species of hollies. They grow in

Fred Whitehead, Earth Scenes

The holly tree has shiny green leaves and red berries.

many temperate and tropical regions of the world. About 15 species are native to the United States and Canada. The American holly is usually 40 to 50 feet (12 to 15 meters) tall. Its dark green leaves have a leathery surface and spines along the edges. It grows throughout most of the eastern United States. The red fruits are not real berries, but *drupes,* which are fruits with stones. They appear only on the pistillate, or female, trees. Holly berries are poisonous.

The English holly is a favorite ornamental tree in the United Kingdom. Sometimes it is planted in hedges. The white flowers of the holly bloom in May, the same month as those of another hedge plant, the hawthorn. Together, they make the English countryside white with blossoms.

Holly wood is very hard and has a close grain. It is valuable for musical instruments, furniture, and interior decoration. The inner bark yields the sticky material called *birdlime.* The leaves of a South American species are used to make a tealike drink called *maté.*

Jerry M. Baskin

Scientific classification. The holly tree is in the family Aquifoliaceae. The different species make up the genus *Ilex.* The American holly is *I. opaca.* The English holly is *I. aquifolium.*

See also **Tree** (Familiar broadleaf and needleleaf trees [picture]).

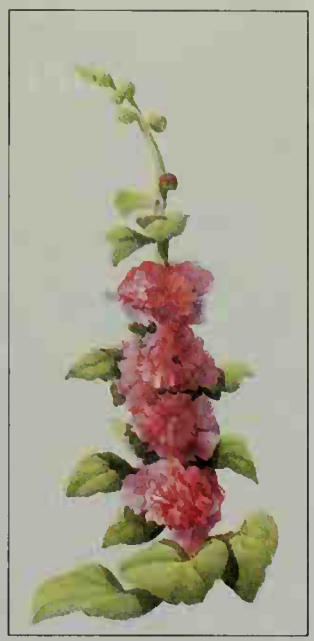
Holly, Buddy (1936-1959), was an American singer, composer, and electric guitarist. He became one of the first major performers of rock music. Holly gained fame in 1957 when his band, the Crickets, recorded "That'll Be the Day." That same year, he recorded his first solo hit, "Peggy Sue." He was co-composer of both songs. Holly and his band developed an energetic style that combined elements of country music with a strong rock 'n' roll rhythm. This style influenced many American and British rock performers. The Beatles took their name as a tribute to the Crickets.

Howard Frank

Buddy Holly

Holly was born in Lubbock, Texas. His full name was Charles Hardin Holley. He began playing the piano when he was 11 years old but soon turned to playing the guitar. He performed as a country singer during the early 1950's. Holly died in a plane crash near Mason City, Iowa, at the age of 22.

Don McLeese



WORLD BOOK illustration by Robert Hynes

Hollyhock

Hollyhock is a tall, hardy plant grown for its large spires of colorful flowers. It is native to Asia but is grown widely in the United States. Its large, fuzzy, heart-shaped leaves start as low rosettes. Tall, heavy stems rise to bear the flower spires. Hollyhocks bloom from July to early September. They are used as background borders or along fences. The flowers are round and open wide. Their colors range from white, through yellow, salmon, and red, to purple.

Most hollyhocks are perennials that usually bloom the second year. They can be started outdoors. But some gardeners start hollyhocks in a frame in July and then transplant them to their garden the following spring. Annual hollyhocks bloom the same year that the seeds are planted.

Hollyhocks thrive in well-drained soil and full sunlight. When the flowers fade, the plant stalks lose their attractiveness, and can be cut down. A few stalks can be left standing if seed is desired. A fungal disease called *rust* sometimes attacks hollyhocks. W. Dennis Clark

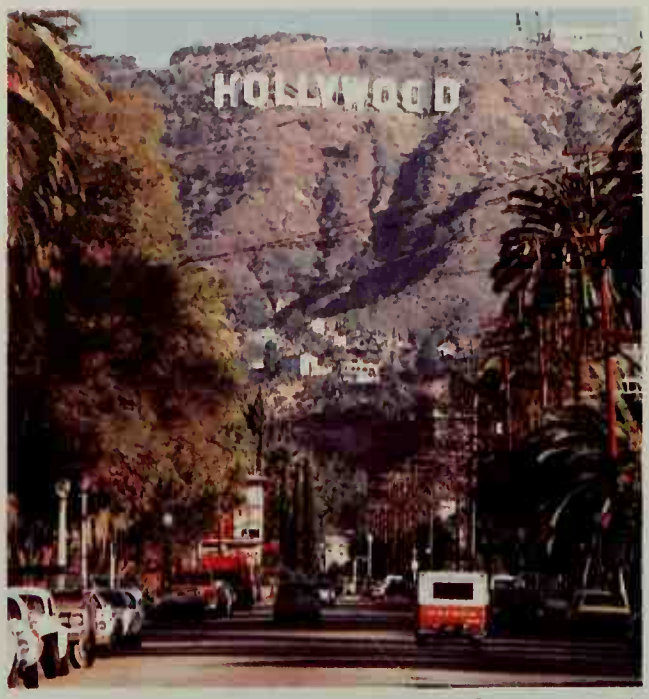
Scientific classification. Hollyhock belongs to the mallow family, Malvaceae. It is *Alcea rosea.*

See also **Flower** (picture: Garden biennials); **Mallow.**

Hollywood, California, is generally considered the motion-picture capital of the world. It is not an incorporated city, but a district of Los Angeles. Hollywood extends from Griffith Park and Mulholland Drive on the north to Melrose Avenue on the south, and from about Hyperion Avenue on the east to about Crescent Heights Boulevard on the west. About 300,000 people live in this area. For location, see **Los Angeles** (map).

The Hollywood Bowl, an open-air theater, is famous for its symphony programs, concerts, and Easter services. The popular Walk of Fame consists of more than 2,000 bronze stars set in the sidewalks along Hollywood Boulevard and Vine Street. Each star has the name of a different Hollywood celebrity. The huge "Hollywood" sign, a landmark built in the hills above the district in 1922, was restored in 1978. Each letter of the sign is 45 feet (14 meters) tall. Hollywood was long known for "The Strip," a section of Sunset Boulevard with many restaurants, gift shops, theatrical agencies, and nightclubs. The section of Hollywood that included "The Strip" was incorporated in 1984 as the city of West Hollywood.

One adobe hut stood on the site of Hollywood in



© Craig Aurness, West Light

Hollywood is known as the world's motion-picture capital. The landmark "Hollywood" sign stands in the hills above the district.

1853. By 1870, the area had many farms. It was incorporated as Hollywood in 1903, but voted to join Los Angeles in 1910 to gain access to that city's water supply.

The Nestor Company built the first motion-picture studio in Hollywood in 1911. Hollywood became a center of the motion-picture industry because it has a mild, dry climate, and because it lies in an area with a vast variety of natural scenery. Within 200 miles (320 kilometers), almost every kind of scenic background is available to moviemakers. The production of sound films began in Hollywood in the late 1920's and resulted in the building of huge sound stages, many now used for making television films. Kenneth Reich

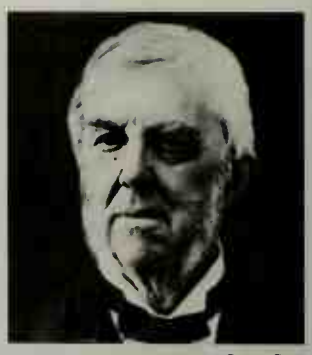
See also **Motion picture.**

Holm, Hanya (1893-1992), was a dancer, *choreographer* (creator of dances), and dance teacher. She became best known for her choreography in *Kiss Me, Kate* (1948); *The Golden Apple* (1954); *My Fair Lady* (1956); and other Broadway musicals. Her choreography was praised for the way it fit with the dramatic action of the plays. Holm also choreographed *Trend* (1937) and *Tragic Exodus* (1939) for the modern dance concert stage, and dances for operas, films, and television.

Hanya Holm was born in Worms, Germany. She was an original member of the dance group formed by Mary Wigman, a leader of modern dance in Germany. Holm moved to New York City in 1931 to found a branch of the Wigman school. She opened a school under her own name in 1936. Katy Mathesnn

Holmes, David. See Mississippi (Statehood).

Holmes, Oliver Wendell (1809-1894), was an American writer who won fame for his essays and poems. He was also a physician and taught at the Harvard Medical School during the years of his greatest literary success. Holmes was known for his keen mind and charming, witty literary style. His enthusiasm and humor made him popular as a teacher and public speaker. His son, Oliver Wendell Holmes, Jr., became a famous associate justice of the Supreme Court of the United States.



Brown Bros.

Oliver Wendell Holmes

His life. Holmes was born in Cambridge, Mass., where his father was a prominent Congregationalist minister. As a youth, Holmes rebelled against the strict religious beliefs of his father. Holmes later supported liberal religious opinions in many of his speeches and writings.

In 1829, Holmes graduated from Harvard College and entered law school. But law bored him and, in 1830, he began to study medicine. He studied at the Harvard Medical School and with private physicians in Boston and Paris. While a student, Holmes wrote many poems. They included "Old Ironsides" (1830), which protested the U.S. Navy's plan to destroy the *Constitution,* a historic but unseaworthy frigate. The poem helped save the ship. See **Constitution** (ship).

In 1836, Holmes received an M.D. degree from Harvard and became a Boston physician. He married Amelia Lee Jackson in 1840. They had two sons and a daughter.

Holmes gained recognition by writing outstanding articles on medical subjects. His most important article was called "The Contagiousness of Puerperal Fever" (1843). Puerperal fever, which once killed many women, resulted from unsanitary conditions during childbirth. Medical workers of Holmes's time paid little attention to cleanliness. Holmes showed that physicians could help prevent the disease simply by washing their hands and putting on clean clothes before delivering babies. His publication helped save many lives. Holmes later considered it his greatest achievement.

In 1847, Holmes was appointed dean of the Harvard Medical School and professor of anatomy and physiology. He served as dean until 1853 and taught until 1882. Holmes was generally assigned the last period of the morning for his lectures because his enthusiasm and humor kept tired, hungry students interested in their work.

Holmes also became popular as a public speaker. Through the years, he wrote and recited amusing poems for many special events and presented lively lectures on literature. His warmth and sense of fun won him many friends, including several leading authors.

In 1857, Holmes helped James Russell Lowell and other writers launch a new magazine. Holmes named it the *Atlantic Monthly* and joined the staff as a columnist. His wise, witty column made both Holmes and the *Atlantic Monthly* famous. Holmes continued to publish essays, fiction, and poetry until he was in his 80's.

His writings. Most of Holmes's poems are more like popular verse than serious poetry. But many are notable for their accurate descriptions of nature or their understanding of human character. His best-known poems, in addition to "Old Ironsides," include "The Last Leaf" (1831), "The Chambered Nautilus" (1858), "Contentment" (1858), and "The Deacon's Masterpiece: or, The Wonderful 'One-Hoss Shay' " (1858).

Holmes's best-known book, *The Autocrat of the Breakfast-Table* (1858), consists of his first 12 essays for the *Atlantic Monthly*. Each essay supposedly tells about a lively, witty conversation that takes place at the breakfast table of a boarding house. The talk actually expresses the author's own observations and opinions on many subjects, including human nature, manners, religion, and science.

Holmes also wrote three novels—*Elsie Venner* (1861); *The Guardian Angel* (1867); and *A Mortal Antipathy* (1885). All three promote Holmes's liberal religious views, but none ranks as outstanding fiction. In "Mechanism in Thought and Morals," a lecture given in 1870, Holmes explored the subconscious mind, which he called "the underground workshop of thought." He wrote this brilliant work more than 20 years before the great Austrian psychiatrist Sigmund Freud published his description of the subconscious. Samuel Chase Coale

See also **American literature** (The Era of Expansion [1831-1870]); **Holmes, Oliver Wendell, Jr.**

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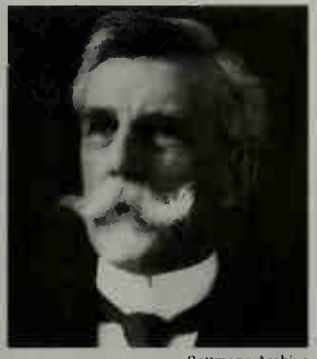
Holmes, Oliver Wendell, Jr. (1841-1935), was one of the best-known American judges of the 1900's. He served as a member of the Supreme Court of the United States for nearly 30 years. During that period, he made great contributions to the changing concepts of law. His keen intellect, humor, and ability to express himself helped to direct American thought.

Early life. Holmes was born in Boston, and was named for his famous father, the writer and physician. He enlisted in the Union Army, fought through most of the Civil War (1861–1865), and was wounded three times. Holmes resigned as a lieutenant colonel in 1864.



Bettmann Archive

Oliver Wendell Holmes, Jr.

As a young man, Holmes was a close friend of the American philosopher William James, and thought of becoming a philosopher himself. Law, he said, was "a rag bag of details." Yet, at the end of his war service, he entered Harvard Law School at the urging of his father. Early in his career, he became coeditor of the *American Law Review* and wrote his great work, *The Common Law* (1881). In 1882, he became a professor of law at Harvard and was appointed to the Supreme Judicial Court of Massachusetts. He became chief justice of Massachusetts in 1899.

Supreme Court justice. President Theodore Roosevelt appointed Holmes an associate justice of the Supreme Court of the United States in 1902. At that time, the court was declaring many state laws unconstitutional because they did not conform to the judges' concept of "due process of law." Holmes insisted that this phrase in Amendment 14 had not been intended to deny the states a right to experiment with social legislation (see **Constitution of the United States** [Amendment 14]). He protested so often when the court seemed to write its economic theories into the Constitution that he became known as the *Great Dissenter*. He was often joined in his dissents by Associate Justice Louis D. Brandeis. In later years, as new judges replaced some of the conservatives, the court accepted the ideas in many of Holmes's dissents.

Much of the legislation Holmes voted to save was designed to improve social conditions. But he was not primarily a reformer. He believed in bigness, and often expressed admiration for industrial tycoons. His dissents did not indicate that he approved the laws that the majority was striking down. Rather, he dissented because he believed that judges have no right to interfere with legislative policy unless it violates the Constitution.

"The life of the law," Holmes wrote, "has not been logic; it has been experience." By insisting that the court look at facts in a changing society, instead of clinging to worn-out slogans and formulas, Holmes exercised a deep influence on the law. He influenced judges to keep from allowing their personal opinions to affect their decisions. This doctrine, known as *judicial restraint*, has since come to dominate American judicial thinking.

Holmes's sharp phrases as well as his philosophy caught the public imagination. People understood him because he was "down to earth." In some respects, he is more famous as a philosopher than as a judge.

With all his brilliance, Holmes was a man of many contradictions. His inclination to let the states experiment led to some opinions now regarded as illiberal. His major contribution was in convincing people that the law should develop along with the society it serves.

Holmes is one of the few judges of his time who could truthfully say that he felt "the secret isolated joy of the thinker, who knows that, a hundred years after he is dead and forgotten, men who never heard of him will be moving to the measure of his thought."

Bruce Allen Murphy

See also **Supreme Court of the United States.**

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Holmes, *hohmz* or *hohlmz,* **Sherlock,** is the most famous detective in fiction. He was created by Sir Arthur Conan Doyle, an English author, and appears in 56 short stories and 4 novels.

Holmes is known for his ability to solve baffling crimes through clever observation and logical deduction. He draws amazing conclusions from minute details. Holmes's remarkable powers of concentration and his broad knowledge of science also help him solve many mysteries.

Holmes is assisted by his friend Dr. John Watson, who records most of Holmes's cases. The two men live in London at 221B Baker Street. Doyle described their quarters so realistically that many readers have visited Baker Street in order to search for the fictional address.

Holmes is a tall, thin man with a lean, narrow face. He

is often pictured wearing a close-fitting cap and smoking a pipe. Holmes has many interests besides detective work. For example, he is an accomplished violinist and an expert on beekeeping.

Doyle introduced Holmes in the novel *A Study in Scarlet* (1887). He modeled him partly after Joseph Bell, a Scottish physician known for making brilliant diagnoses through observation. David Geherin

See also **Doyle, Arthur Conan.**

Holmium, *HOHL mee uhm* (chemical symbol, Ho), is one of the rare-earth metals. Its atomic number is 67, and its atomic weight is 164.93032. The Swiss scientist J. L. Soret first identified the element in 1878. In 1879, P. T. Cleve of Sweden independently discovered, and also named, the element. The name comes from *Holmia,* the Latin word for Stockholm, Sweden.

Holmium occurs in monazite and similar minerals that bear rare earths. It is best separated from other rare earths by ion exchange processes or by solvent extraction. The metal has a silver color. It melts at 1474 °C and boils at 2700 °C. Its density is 8.78 grams per cubic centimeter at 25 °C. The cream-colored oxide Ho_2O_3 is soluble in mineral acid. Larry C. Thompson

See also **Element, Chemical; Rare earth.**

Holocaust, *HAHL uh kawst,* was the systematic, state-sponsored murder of Jews and others by the Nazis during World War II (1939-1945). The Nazi dictator Adolf Hitler wanted to eliminate all Jews as part of his aim to conquer the world. By the end of the war, the Nazis had killed about 6 million Jewish men, women, and children—more than two-thirds of the Jews in Europe.

In addition to Jews, the Nazis systematically killed millions of other people whom Hitler regarded as racially inferior or politically dangerous. The largest groups included (1) Germans with physical handicaps or mental retardation, (2) Gypsies, and (3) Slavs, particularly Poles and Soviet prisoners of war. Nazi victims also included many homosexuals, Jehovah's Witnesses, priests and ministers, members of labor unions, and Communists and other political opponents. Historians estimate that perhaps as many as 11 million people were killed, including the Jews. Many of the Holocaust victims were killed in specially constructed gas chambers, and their bodies were then burned. The word *holocaust* means *a sacrificial offering that is completely burned.*

Before the Holocaust

The Jews had faced persecution long before the Holocaust began. *Anti-Semitism* (prejudice against Jews) has existed since ancient times. Many early Christians mistrusted Jews because the Jews remained faithful to their own traditions and refused to convert to Christianity. In the mid-1500's, the religious reformer Martin Luther issued ferocious attacks against the Jews for not adopting his new religion. He referred to the Jews as "venomous" and called for violence against them. In many cities, the Jews were forced to live in separate communities called *ghettos.* They had to pay special taxes, and they were not allowed to own land or to enter certain occupations.

In the 1800's, many people began discriminating against Jews on racial rather than religious grounds. Many anti-Semitic writers insisted that Jews were an inferior race. Anti-Semitism became a powerful force in European politics. Many people considered the Jews responsible for society's troubles. In 1881, for example, when revolutionaries assassinated Czar Alexander II of Russia, the Jews were blamed. Many Russian Jews were then killed in organized massacres called *pogroms.*

In 1894, Captain Alfred Dreyfus, a French army officer and a Jew, was accused of selling military secrets. Although the case against Dreyfus was weak, a court-martial condemned him to life imprisonment. After the verdict was announced, his opponents chanted in the streets, "Death to Dreyfus! Death to the Jews!" In 1906, he was cleared of all charges.

Adolf Hitler, the leader of the Nazi Party, became head of the German government in 1933. He quickly moved to make himself a dictator. Germany's defeat in World War I (1914-1918) and a worldwide depression in the early 1930's had left the country's economy in ruins. Hitler blamed the Jews for Germany's problems, and he made anti-Semitism a government policy.

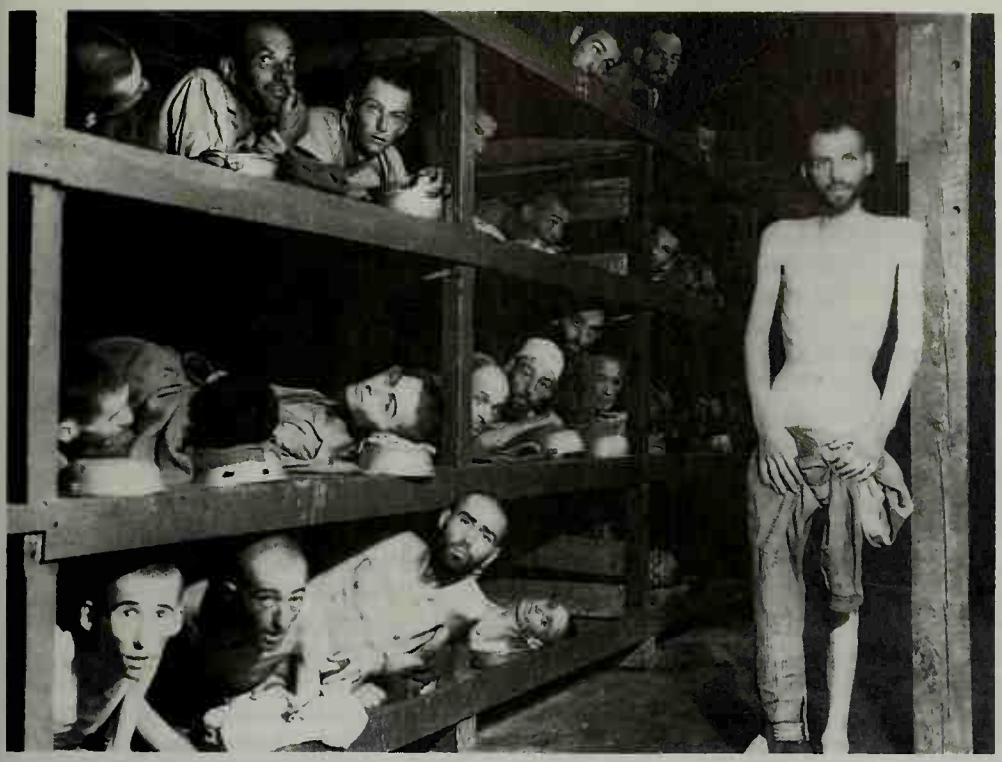
On April 1, 1933, Hitler's government sponsored a nationwide boycott of Jewish stores and other businesses. In the next several months, the government passed a number of laws that barred Jews from specific occupations. Jews were excluded from civil service, for example, and from the fields of education and culture, and they could no longer farm the land.

The Nuremberg laws of 1935 stripped Jews of citizenship. Jews were forbidden to marry non-Jews. The laws set forth definitions of who was a Jew and who was a part-Jew, also known as a *Mischling* (mixed blood). For example, a person who had at least three Jewish grandparents was classified as a Jew. Someone with one Jewish grandparent might be classified as a Mischling.

In the next three years, the Nazi government continued to deprive Jews of their rights and possessions. Jews could not sit on park benches or swim in public pools. The government seized Jewish businesses as well as personal property. The discrimination was an effort to force Jews to emigrate so Germany would be *Judenrein*

Yad Vashem Archives

During the Holocaust, the Nazis killed millions of Jews and others. This photo shows Jews being forced from their homes.



UPI/Corbis-Bettmann

Holocaust victims include these starving prisoners at Buchenwald, one of the many concentration camps the Nazis established during the 1930's and 1940's. Many inmates died of starvation and disease or were worked to death. There were also six death camps, where the Nazis killed their prisoners with poison gas.

(free of Jews). Thousands of Jews did leave the country, though they were permitted to take little with them. But many Jews were trapped because other countries would not accept them in large numbers.

The Nazi persecution reached a new height on Nov. 9, 1938. Beginning that night and continuing for about 24 hours, Nazis destroyed thousands of Jewish-owned businesses and burned most synagogues in Germany and Austria. They beat Jews in the streets and attacked them in their homes. They killed dozens of Jews. They arrested about 30,000 Jews and sent them to *concentration camps* (camps for political prisoners). The night became known as *Kristallnacht,* a German word meaning *Crystal Night.* In English, it is called the Night of Broken Glass.

The Holocaust

"The Final Solution." After World War II began in 1939, Germany's powerful war machine conquered country after country in Europe. Millions more Jews came under German control. The Nazis killed many of them and sent others to concentration camps. The Nazis also moved many Jews from towns and villages into city ghettos. They later sent these people, too, to concentration camps. Although many Jews thought the ghettos would last, the Nazis saw ghetto confinement as only a temporary measure. Sometime in early 1941, the Nazi leadership finalized the details of a policy decision labeled "The Final Solution of the Jewish Question." This policy called for the murder of every Jew—man, woman, and child—under German rule.

The slaughter began with Germany's invasion of the Soviet Union in June 1941. Special squads of Hitler's SS (Schutzstaffel) troops accompanied advancing German forces. These killing squads, called *Einsatzgruppen,* rounded up Jews, Gypsies, and Soviet leaders, and shot them to death one by one. The face-to-face killing became difficult for the killers, and the Nazis soon sought a more impersonal and efficient method of *genocide* (extermination of an entire people). They began using sealed vans. The prisoners choked to death on exhaust fumes as the van traveled to a burial pit.

At the Wannsee Conference, held in Berlin in January 1942, Nazi leaders further systematized the killing. They decided that Jews throughout German-occupied territory would be evacuated to concentration camps in eastern Europe. These camps would become centers for slave labor and extermination.

The camps. The first Nazi concentration camps were organized in 1933, shortly after Hitler came to power. By the late 1930's, the facilities held tens of thousands of political prisoners arrested by the Nazis. In the early 1940's, several new camps were established, with specially constructed gas chambers disguised as showers.

For the Jews who had been confined in ghettos, the next step was what the Nazis called *deportation.* The Nazis herded the Jews into railroad freight cars to be taken to the camps.

When the Jews arrived at a camp, an SS physician singled out the young and able-bodied. The others were sent directly to the gas chambers. The guards seized the belongings of those who were to die. As many as 2,000 prisoners were sent into the gas chambers at one time. SS personnel poured containers of poison gas down an opening. Within 20 to 30 minutes, the new arrivals were dead. The guards shaved the heads of the corpses and removed any gold teeth from their mouths. Then they burned the bodies in crematoriums or open pits.

The able-bodied prisoners had their heads shaved and their belongings seized. Camp personnel tattooed a number on the arm of each person. From then on, the prisoners were identified by number instead of by name. These prisoners were forced to work long hours under cruel conditions. When they were too weak to work any longer, they too were killed or left to die.

There were six death camps, all in German-occupied Poland—Auschwitz, Belzec, Chelmno, Majdanek, Sobibor, and Treblinka. Auschwitz was the largest and most notorious. It was a slave labor camp as well as a killing center. About $1\frac{1}{4}$ million people were murdered there.

Hundreds of other concentration camps operated in Germany and German-occupied territories during the war. None of these camps was established solely for killing, but the conditions in all of them were so harsh that hundreds of thousands of prisoners died of starvation and disease. In some camps, a number of inmates—many of them children—died after Nazi physicians performed cruel medical experiments on them.

In the last months of the war, the Allied forces, including American, British, and Soviet troops, swept through Europe. The Nazis hastened to empty some camps to remove witnesses to their cruelty. They crowded camp inmates into boxcars or forced the prisoners to walk to other camps behind the lines. The forced marches, made in winter with few provisions, claimed so many victims that they were known as *death marches.*

Resistance. During the Holocaust, the Nazis kept their actions as secret as possible, and they deceived their victims in many ways to prevent resistance. Initially, the Jews in the ghettos either were not aware of the slaughter planned for them or could not believe it was happening. Some tried to pacify the Nazis, hoping they would be left in peace. Others tried sabotage or escape.

Armed resistance was not the first response of the Jews. It was difficult and dangerous for the Jews to obtain weapons. Anti-Semitism was widespread, and Jewish resistance did not have popular support. Jewish leaders in the ghettos knew that the Nazis could kill everyone in the ghetto in revenge for the actions of a few resisters. But many Jews who managed to escape the ghettos joined secret bands of fighters against the Nazis. And some non-Jewish individuals risked their lives to smuggle Jews to safety.

Some Jews in ghettos, slave labor camps, and death camps did fight. In 1943, for example, thousands of Jews revolted in the ghetto in Warsaw, Poland. Although the Jews were surrounded and poorly armed, they held out for about four weeks. But the Nazis either killed or sent to death camps all of the 60,000 Jews in the ghetto.

In a 1944 revolt at Auschwitz, prisoners blew up a crematorium, and a small number escaped. But such resistance was often an act of desperation. It erupted when the Jews understood Nazi intentions and had abandoned hope of survival.

After the Holocaust

A Jewish homeland. As the Allies advanced through Europe in 1944 and 1945, they found millions of *displaced persons* living in countries not their own. Most of these people, including many Jews, eventually returned to their homelands. However, many of the Jews had nowhere to go. Their homes had been destroyed, and their families murdered. The presence of so many Jews on German soil, living among their former killers, pressured world leaders to find a place where the Jews could go. The Jews themselves wanted an independent Jewish state in Palestine, the ancient Jewish homeland in the Middle East.

In the late 1800's, members of a Jewish movement called Zionism had begun promoting immigration of Jews to Palestine. In the early 1900's, the British rulers of Palestine had pledged support for a national homeland there for the Jews. But the Arabs who lived in the area had opposed it, and severe fighting had broken out several times during the 1920's and 1930's. In 1939, the British had begun limiting Jewish immigration to Palestine to gain Arab support for the Allies in World War II. Both during and after the war, Palestine's Jews fought bitterly against the restrictions. The British submitted the problem to the United Nations (UN). In 1947, the UN proposed dividing Palestine into an Arab state and a Jewish one. In May 1948, the state of Israel officially came into existence and opened its borders to receive the Jews.

The Nuremberg Trials. In 1943, Allied leaders declared their determination to bring the Nazi leaders to justice for their wartime behavior. The outrage of the Allies intensified during the final months of the war, when the killing centers were discovered. The Nuremberg trials took place from 1945 to 1949 in Nuremberg, Germany, where the Nazi Party had staged huge rallies.

The Nazi leaders were charged with four major types of crimes—conspiracy to commit crimes against peace, crimes against peace, war crimes, and crimes against humanity. Conspiracy to commit crimes against peace included the planning of a war of aggression. Crimes against peace included carrying out such a war. War crimes included the murder of prisoners of war and of civilians, and the destruction of towns and cities. Crimes against humanity included deporting civilians and using them for slave labor as well as persecuting and murdering people for their political beliefs, race, or religion.

On Dec. 9, 1948, the United Nations passed the Genocide Convention, making genocide a crime. It was designed to overcome the claims of Nuremberg defendants that they had violated no law. The next day, the UN adopted the Universal Declaration of Human Rights.

In the 1990's, Jewish groups pressured those who had profited from the Holocaust to compensate Holocaust victims or their descendants. Groups that paid reparations included the German government, certain Swiss banks, and some German companies.

Michael Berenbaum

Related articles in *World Book* include:

Biographies

Eichmann, Adolf
Frank, Anne
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Schindler, Oskar
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Wiesel, Elie
Wiesenthal, Simon

Other related articles

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Babi Yar
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Holocaust Memorial Museum, United States
Jews (The Holocaust)
Kristallnacht
Mein Kampf
Nazism
Nuremberg Trials
Treblinka
War crime (World War II)

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Holocaust Memorial Museum, United States, is devoted to remembering the Holocaust—the mass murder of Jews and other minorities by the Nazis from 1933 to 1945. The museum, which is in Washington, D.C., features films, photographs, eyewitness accounts, and various objects from the time. It also houses a library and other facilities dedicated to the study of the Holocaust.

The museum's exhibits are arranged to follow the history of the Holocaust. They begin with the rise of Nazism during the 1930's and conclude with the Allied liberation of concentration camps at the end of World War II. The thousands of objects on display include a train car used to take Jews to concentration camps and containers of the poison gas the Nazis used in gas chambers.

In 1980, Congress established the United States Holocaust Memorial Council to oversee the construction of a museum honoring the victims of the Holocaust. Funds for the museum came from private donations. The museum opened in 1993.

See also **Holocaust; Washington, D.C.** (map).

Holography, *huh LAWG ruh fee,* is a method for storing and displaying a three-dimensional image, usually on a photographic plate or another light-sensitive material. The exposed plate is called a *hologram.* Some credit cards contain holograms to prevent counterfeiting. Holograms also appear in advertising displays, artwork, and jewelry. Holography may be used to detect flaws in tires, lenses, airplane wings, and other products.

Holography involves two basic steps: (1) creating a hologram and (2) illuminating the hologram to display the image. During the first step, a beam of laser light is reflected off a subject and onto a light-sensitive material, such as a photographic plate. Another laser beam, called the *reference beam,* also shines on the plate. Where these two light beams cross on the plate, they make a complex, microscopic pattern of bright and dark stripes (see **Interference**). In the second step, a light beam traveling in the same direction as did the reference beam illuminates the hologram. The hologram changes the direction of light waves in this beam so that the waves appear to come from the original illuminated subject. The resulting three-dimensional image seems to hover in space. Illuminating the hologram with *white light,* such as sunlight, produces an image containing rainbowlike bands of color. Using a beam of a single color, such as a laser beam, avoids this effect.

Dennis Gabor, a Hungarian-born engineer, invented holography in 1947. For this work, Gabor won the 1971 Nobel Prize in physics. Jack Feinberg

Holst, Gustav (1874-1934), was an English composer and teacher. Holst composed many of his works for vocal soloists and chorus. These compositions show his sensitivity to the human voice and to language as well as his love for the English folk song tradition. However, Holst's best-known work is the orchestral suite *The Planets* (1914-1916). This suite consists of seven parts, each interpreting the astrological nature of a planet.

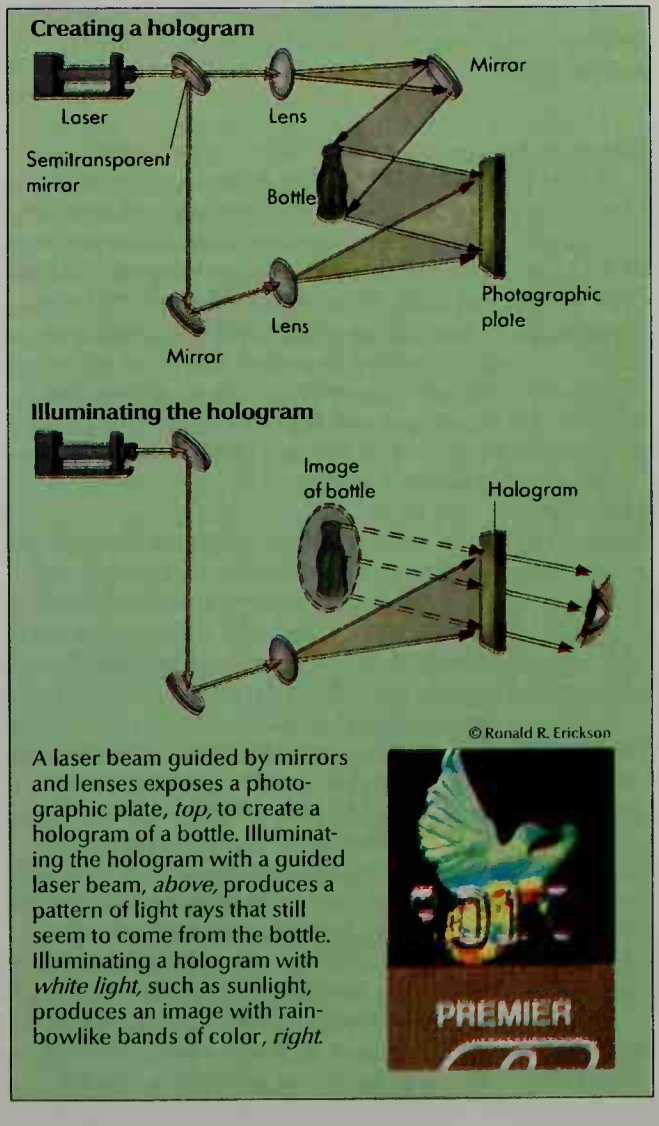
Holst composed two famous suites for military band (1909, 1911) based on English folk songs. He was one of the first composers to write quality music for the wind band. The Hymn of Jesus (1917) is a work for orchestra and chorus based on the apocryphal books of the Bible. The poetry of John Keats inspired Holst's First Choral Symphony (1925) for soprano, chorus, and orchestra. Holst also wrote several works that reflect his interest in Hindu literature. Gustavus Theodore von Holst was born on Sept. 21, 1874, in Cheltenham of Swedish parents.

Stewart L. Ross

Holy Alliance was an agreement signed in Paris in September 1815, after the fall of Napoleon. Czar Alexander I of Russia originated the Alliance. The first two signers were Francis I, emperor of Austria, and King Frederick William III of Prussia. All the rulers in Europe except the pope, the king of the United Kingdom, and the sultan of Turkey also signed it. The purpose of the Alliance was to unite the monarchs of Europe in a holy brotherhood to advance Christian principles in opposition to revolutionary disorder. The agreement said that charity, justice, and peace should be the basis of international relations. The Holy Alliance symbolized a new unity of purpose among Europe's great conservative powers.

How holography works

WORLD BOOK illustration by Mark Swindle



A laser beam guided by mirrors and lenses exposes a photographic plate, *top,* to create a hologram of a bottle. Illuminating the hologram with a guided laser beam, *above,* produces a pattern of light rays that still seem to come from the bottle. Illuminating a hologram with *white light,* such as sunlight, produces an image with rainbowlike bands of color, *right.*

Detail of an illuminated manuscript (about 1470) by an unknown French artist; Bibliothèque Nationale, Paris (Giraudon/Art Resource)

The Holy Grail appeared in a vision to King Arthur and his knights as they sat around the Round Table in Arthur's castle.

However, the agreement had little practical effect.

People often confuse the Holy Alliance with the Quadruple Alliance, in which four nations—Austria, Britain, Prussia, and Russia—organized in 1815. The purpose of the Quadruple Alliance was to preserve peace in Europe. But the Austrian, Prussian, and Russian monarchs soon began to use their power to preserve their own authority. They intervened in several countries against liberal and nationalist movements that sought greater freedom for the people and self-government for peoples under the monarchs' rule. Peter N. Stearns

See also **Alexander I** (czar).

Holy Ghost. See Trinity.

Holy Grail, in its earliest form in medieval legend, was a mysterious food-producing vessel. It was usually depicted as a dish or cup, or sometimes a magical stone. The Grail later became identified with the vessel of the Last Supper. Joseph of Arimathea used it to catch the blood of Jesus as He hung from the cross.

European poets established the basic parts of the Holy Grail story between about 1180 and 1240. They may have adapted the legend from a tale told much earlier by pagan Celtic people. The Celtic story described a magic cup or dish. Chrétien de Troyes, a French poet, wrote an unfinished poem about the Grail that later writers completed. Chrétien's poem became the best-known Grail story. Another poet, Wolfram von Eschenbach of Germany, wrote an important account of the legend that he based, at least partly, on Chrétien's work.

Early history of the Grail. According to a version that developed from Robert de Boron about 1200, the Grail story begins with Joseph of Arimathea. The Romans imprisoned Joseph because he had been a follower of Jesus. While Joseph was in prison, the Grail mysteriously appeared to him. After being freed, Joseph led a group of Christians who carried the Grail throughout the Holy Land.

Joseph later took the Grail to Britain, where he built a castle called Corbenic. He kept the Grail in the castle. Joseph and his descendants served as rulers of Corbenic and guardians of the Grail. The legend tells how Pelles, one of the castle rulers, suffered a wound that did not heal. According to the version found in Chrétien and Wolfram, the young knight Perceval accidentally came to the Grail castle, where he witnessed the Grail procession. Later, he actively sought the Grail.

The search for the Grail. Later versions of the quest of the Holy Grail replaced Perceval with Galahad, and the quest itself became the main adventure of King Arthur's Knights of the Round Table. According to versions found in the French Vulgate Cycle (about 1215) and in Sir Thomas Malory's *Le Morte Darthur* (1470), on the feast of Pentecost, the knights gathered in a hall in Arthur's castle. Suddenly, in a brief vision, they saw the Grail suspended in the air. About 150 knights decided to search throughout Britain for the Grail.

The knights underwent many dangerous adventures during their search. Their actions during these adventures revealed that only three knights—Bors, Galahad, and Perceval—were morally perfect and therefore fit to complete the quest. After searching for years, the three knights, with nine men from other lands, entered Castle Corbenic. There they saw a vision in which Joseph of Arimathea appeared as a priest. Angels brought in the Grail and the bloody spear that had pierced Christ's side during the Crucifixion. A child appeared above the Grail and changed into bread. Then Christ emerged from the cup and gave Communion to the men. The vision was meant to prove that, in the Mass, the bread and wine are changed into the body and blood of Christ.

Galahad healed Pelles with blood from the holy spear. After leaving the castle, the three knights sailed on a ship which, they discovered, carried the Grail. Guided by supernatural forces, the ship took the knights and the Grail to the distant city of Sarras. There, after Galahad died, Bors and Perceval saw the Grail rise into heaven. According to the legend, no one has seen the Holy Grail since that time. Edmund Reiss

See also **Chrétien de Troyes; Galahad, Sir; Wolfram von Eschenbach.**

Holy Land. See Palestine.

Holy Roman Empire was a German-based empire in western and central Europe that began in A.D. 962 and lasted until 1806. It was associated with the Roman Catholic Church but often suffered because of disputes between the Holy Roman emperors and the popes. The powerful Habsburg (also spelled Hapsburg) family ruled the empire for nearly 400 years.

Some scholars trace the origins of the Holy Roman Empire to an empire founded by the great ruler Charlemagne. Charlemagne's empire included most of what is now France, Germany, and Italy. In A.D. 800, Pope Leo III crowned Charlemagne emperor of the Romans. But the empire fell apart after Charlemagne died in 814. In the mid-900's, King Otto I of Germany gained control of most of northern and central Italy. In 962, Otto had Pope

WORLD BOOK map

The Holy Roman Empire in 1250 extended from the North Sea to the Mediterranean Sea. The Kingdom of the Two Sicilies, a personal possession of the emperor, was geographically separated from the empire by the Papal States.

John XII crown him emperor of what became known during the 1200's as the Holy Roman Empire.

Problems of the empire. From the start, the empire faced serious problems. The emperor's authority was often challenged by powerful German nobles and unfriendly popes. The emperor's difficulties were made worse because he was chosen by election. Until the mid-1400's, strong nobles often disputed the election results, and these challenges sometimes led to civil war. Before 1500, the great size of the empire also made it difficult for the emperors to rule it effectively.

Problems with the popes began in the mid-1000's, when Holy Roman Emperor Henry IV and Pope Gregory VII tried to establish authority over each other. Popes and the emperors fought for authority until 1250, when Pope Innocent IV and the Italian city-states gained almost complete independence from the empire.

The German nobles gained power during the struggle between the emperors and the popes. They were particularly powerful during the period from 1250 to 1273. In this period, called the *Interregnum,* there was no emperor at all. After elections for emperor resumed, the nobles chose an almost continuous succession of weak rulers for about 150 years.

The House of Habsburg. Albert II of the Habsburg family became Holy Roman emperor in 1438. The Habsburgs ruled from then to 1740 and again from 1745 to 1806. Many institutions of the empire took their final shape during the early years of the Habsburg period. They included a legislative body, courts, and a military system.

In the first half of the 1500's, the empire was headed by Charles V, the most powerful European ruler since Charlemagne. But Charles V eventually lost much of his power, in part because of the Protestant Reformation, which split Germany into rival Protestant and Roman Catholic groups.

Habsburg power continued to decline as a result of losses in the Thirty Years' War (1618-1648) and the rise of the powerful German state of Prussia in the 1700's. Defeat by French armies during and after the French Revolution (1789-1799) further weakened Habsburg power. In 1806, after France defeated the Habsburgs, Emperor Francis II declared the end of the Holy Roman Empire.

Charles W. Ingrao

Related articles in *World Book* include:

Charlemagne
Charles V (Holy Roman emperor)
Charles VII (Holy Roman emperor)
Ferdinand II
Ferdinand III
Francis II (Holy Roman emperor)
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Germany (History)
Habsburg, House of
Henry III (of Germany)
Henry IV (of Germany)
Henry VI (of Germany)
Maximilian I
Otto I, the Great
Otto II (Holy Roman emperor)
Sigismund
Thirty Years' War

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Holy Scriptures. See Bible (introduction).

Holy Spirit. See Trinity.

Holy Week is the period between Palm Sunday and Easter when Christians remember the final events in the life of Jesus. During this week, churches usually hold special services of worship and meditation.

Palm Sunday, the first day of Holy Week, commemorates Jesus's triumphal entry into Jerusalem, when the people spread palms and garments before Him. Christians in many traditions observe the day with a procession with palm leaves. On Maundy Thursday or Holy Thursday, services focus on the Last Supper of Jesus. Worship may include a foot-washing ceremony, in keeping with Jesus's command to His disciples that they wash each other's feet as He had washed theirs.

In Good Friday services, Christians remember the day of Jesus's Crucifixion. On Holy Saturday, many churches hold the *vigil* (watch) of Easter, when worshipers recall Jesus's burial and await His Resurrection. The vigil marks the start of Easter and often includes a service of light, Holy Baptism, and Holy Communion.

The observances of Holy Week took their present form in the late 300's. Early Christians linked the final events of Jesus's life with the days on which these events were thought to have occurred. Christians related these events with the places in and around Jerusalem where tradition held they took place. For the many pilgrims who visited Jerusalem, worship services were conducted at the churches and shrines that tradition associated with Jesus's last days. As a result, the observances in Jerusalem produced for the entire church a week of special solemnity and services to commemorate the suffering and death of Jesus. David G. Truemper

See also Easter; Good Friday; Lent; Maundy Thursday; Palm Sunday.

Homage, *HAHM ihj,* during the Middle Ages, was a feudal ceremony by which one man became the vassal or follower of a lord. The ceremony set up a personal and honorable tie between the vassal and the lord, who

promised faithfulness to each other. The knight who was to become a vassal knelt before the lord, placed his hands between those of the lord, and acknowledged himself to be the lord's man. The lord then recognized him as a vassal, raised him to his feet, and kissed him. After performing homage, the vassal usually took an oath of fealty, swearing on the Bible or on holy relics to keep the faith he had pledged. Bryce Lyon

See also Feudalism (The principles of feudalism).

Home. See Family; Home economics; House; Shelter.

Home, Lord. See Douglas-Home, Sir Alec.

Home economics is a field of study that focuses on factors that affect the well-being of individuals and families, such as parenting, nutrition, and housing. The field is also known as *family and consumer sciences, human ecology, human sciences, human environmental sciences,* and a variety of other names. Professionals in the field work to enhance the health of individuals and families and the quality of their environments.

Home economics prepares students for a wide range of careers. These careers may involve helping people obtain food, clothing, and shelter; or assisting them in educating and caring for their children and other dependents. Professionals trained in the field may work as researchers, scientists, designers, teachers, social service professionals, writers, consultants, or administrators.

Areas of study

There are many connections between the various areas of study within home economics. Interrelated areas of study include (1) human development and family studies, (2) design, production, and distribution of consumer goods, (3) hospitality management, (4) nutrition, dietetics, and food science, (5) family and consumer sciences education and communications, and (6) consumer economics and family resources management. Programs in these areas often include courses from several other specialized areas.

Human development and family studies focuses on the physical, emotional, psychological, and social development of individuals. It also covers how the interaction between family members affects this development. Students learn to teach family members how to cooperate, make group decisions, and prevent and resolve conflicts. Students may become day-care managers, teachers of young children, marriage and family counselors, or community service professionals.

Design, production, and distribution of consumer goods aims to increase human well-being through material resources for daily life. Programs in this area focus on the design of apparel, the design and production of textiles and home furnishings, and the development and sale of *consumer goods* (items produced for use by individuals and families). Some programs focus on the interior design of homes, offices, stores, hotels, and other buildings. Graduates may have careers as interior or apparel designers, fiber artists, sales or advertising specialists, or managers and buyers for retail companies.

Hospitality management focuses on providing for people's needs away from home. Courses cover hotel and motel management; restaurant, beverage, and food service management; food preparation; nutrition; human relations; marketing; and finance. Graduates can have careers managing hotels and restaurants, or planning conventions and recreational activities.

Nutrition, dietetics, and food science focuses on developing the knowledge and skills needed to ensure that individuals get adequate nutrition. Students in this area study the body's nutritional requirements, the nutritional value of various foods, food safety, the relationship of diet to disease and its prevention, the development of food products, and food service management. Study in this area can lead to a career as a dietitian, public health nutritionist, fitness consultant, or food scientist. Nutrition can be part of a pre-medicine curriculum.

Family and consumer sciences education and communications prepares teachers and other communicators for work in schools, businesses, government agencies, or television and other media. Some graduates work as teachers in schools or universities, or in community programs such as those in the Cooperative Extension Service. Others find careers in advertising, newspaper and magazine journalism, and broadcasting.

Consumer economics and family resource management examines how individuals and families manage money, time, energy, talent, and other resources. Students in this area focus on family financial planning, family and consumer economics, and protecting the interests of consumers. Graduates may work as financial counselors or consumer affairs specialists.

History

Home economics grew as a profession in the United States in the early 1900's. Its founders wished to improve the unhealthful living conditions brought about by the Industrial Revolution, a period of rapid industrialization that had begun in the 1700's. Of special concern were immigrants who worked long hours under unhealthful and unsafe conditions for low wages. Many immigrants also lived in overcrowded conditions with inadequate plumbing and ventilation. City sanitary services and water supplies were poor, and infectious disease was the main cause of death. Professional home economists worked to improve the safety and wholesomeness of food and water, taught people sanitary practices, showed them how to improve their diets and parenting skills, and sought to improve consumer products and fairness for consumers in the marketplace.

Home economics provided educational and professional jobs for women when such jobs were rare. In the mid-1800's, Catharine E. Beecher established schools for young women that taught cooking, child care, home management, and other skills under the name *domestic economy.* Her efforts led to the founding of a home economics movement. In the late 1800's, Ellen Richards, a chemist and the first woman admitted to the Massachusetts Institute of Technology, promoted the application of science to practical problems of the home and family. She played the leading role in changing the movement into a profession at conferences in Lake Placid, New York, in late 1908 and early 1909. Richards and others founded the American Home Economics Association (now the American Association of Family and Consumer Sciences) in 1909. Since then, several other organizations and journals have been established in the field.

Over the years, universities and other institutions began using a variety of names for their home economics programs. In 1993, representatives from a wide range of

home economics organizations and specializations recommended that the field be called *family and consumer sciences*. Since then, professionals in the field have worked to increase the use of the new name.

Home economics began to change greatly in the late 1900's in response to developments in society and the world. These developments included changes in the roles of men and women, fewer families with full-time homemakers, diminishing natural resources, more pollution and waste problems, and greater use of computers and other advanced technologies.

Career requirements

Home economics professionals have at least a bachelor's degree. Many positions require advanced degrees. Students may be required to take courses in the biological, physical, and social sciences. Other studies include home economics courses that teach students to work across specializations as a way to solve real problems of daily life. Some specializations require courses in the arts and humanities. The American Association of Family and Consumer Sciences accredits home economics programs in universities in the United States. It also certifies home economics professionals. Other organizations certify professionals in various specialized fields within home economics. Virginia B. Vincenti

See also **Beecher, Catharine Esther; Family, Career and Community Leaders of America.**

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Home rule is the management of the affairs of a country, county, or city by its own residents. In the United States, the term *home rule* refers to the power of self-government that states give to their cities and counties. State legislatures, unless restricted by their state constitutions, have the right to exercise complete control over local governments. But many states permit home rule in the belief that locally elected officials are much better qualified than state legislators to deal with local matters. Today, most cities have the right to decide how their own government will be organized.

The term *home rule* also refers to independence movements in countries that were once colonies of the United Kingdom (U.K.). The Irish home rule movement began in the late 1800's. The Republic of Ireland cut all ties with the U.K. in 1949. In India, the home rule movement resulted in independence from the U.K. in 1947.

In the 1970's, home rule movements gained strength in Scotland and Wales, which are part of the U.K. Most Scottish and Welsh supporters of home rule want increased control over local government but not complete independence from the U.K. Susan H. Ambler

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City (Governmental problems)
City government
Devolution
Local government
Ireland (The Easter Rising)
United Kingdom (Gladstone and Disraeli)

Home schooling is a form of education in which most of a child's instruction is conducted in the home. An estimated 600,000 to more than 1 million children in the United States are educated at home. Parents are usually the main teachers. Families who educate their children at home typically give lessons in subjects similar to those in public and private schools.

There are many reasons parents choose home schooling for their children. Most parents do so because they want to teach a specific set of values, usually Christian, to their children. Parents may also decide on home schooling because they cannot afford private school for their children. Others may want less structured learning for their children than a typical public or private school provides, or want greater control over the selection of material their children are taught.

Some families organize home schools like a conventional school, with structured daily activities. Others view all of life as an opportunity for learning and use a flexible schedule. Most families provide educational experiences outside as well as inside the home. Their children may visit museums, work in a garden, or serve apprenticeships. Some home-school families use textbooks. Others create their own materials.

Critics argue that home-schooled children may not have enough contact with other children, especially those from different backgrounds. Critics also say that the average parent is not qualified to teach. However, studies show that most home-schooled children achieve scores equal to or better than public-school students in college entrance examinations, achievement tests, and social development tests.

Since the late 1970's, increasing numbers of parents in the United States have begun to teach their children at home. Each state has different laws to govern the operation of home schools. Brian D. Ray

Homeland Security, Office of, is a United States government agency that aims to protect the nation against terrorism. The office coordinates efforts to detect, prepare for, prevent, respond to, and recover from terrorist attacks. It works with numerous federal, state, and local agencies in designing and implementing national strategies. The president appoints the head of the office, who is known as the assistant to the president for homeland security. The office is part of the Executive Office of the President

The duties of the Office of Homeland Security include assisting intelligence-gathering efforts and distributing information to appropriate departments. The office reviews, evaluates, and maintains federal security procedures and emergency response plans. It helps plan protection for important structures and facilities within the United States. The assistant to the president for homeland security determines the agenda for the Homeland Security Council. This council, which includes the heads of a number of executive departments and agencies, advises and assists the president in matters of security in the United States.

President George W. Bush established the Office of Homeland Security in October 2001. This move followed attacks on the World Trade Center in New York City and the Pentagon Building near Washington, D.C., the previous month.

In 2002, Bush proposed that the Office of Homeland Security be expanded into a new executive department called the Department of Homeland Security. The new department, according to Bush's proposal, would then

take over a number of government agencies and responsibilities related to the prevention of terrorism. These agencies could include the Federal Emergency Management Agency, the Immigration and Naturalization Service, the Transportation Security Administration, the U.S. Coast Guard, the U.S. Customs Service, and the U.S. Secret Service. M. Cherif Bassiouni

See also **Ridge, Tom; Terrorism.**

Homelessness is the condition of people who have no permanent place to stay. Millions of people in the world are homeless. Many of them live in poor or developing countries. Millions more people live in what the United Nations calls "relative homelessness." Although these people have a place to live, their housing may not protect them from the weather or provide clean water, sanitation, or personal safety. Also, the housing may be too expensive or too far from jobs, schools, and medical care. Relative homelessness remains a serious problem. But this article will focus on the situation of people in the United States who have no permanent housing.

Current causes and conditions. The main causes of homelessness in the United States are poverty, joblessness, and a shortage of affordable housing. Some people lose their jobs and can no longer pay for housing. Some earn too little to provide for their basic needs. Others have had to leave difficult or abusive personal relationships and cannot support themselves. Some homeless people are former psychiatric patients who have been released into the community without adequate support. Those who abuse alcohol or drugs, or who have a severe mental illness, may find jobs especially hard to get. Such people become homeless sooner and remain homeless longer than others. A shortage of low-cost housing contributes to the problems that all of these people face.

Hundreds of thousands of homeless Americans stay in shelters each week. Others may be found in local jails and hospitals. Some may build a temporary shack or live illegally in an abandoned building. Still others sleep in public buildings, such as airports or train stations; or they spend the night outdoors under bridges, in parks, or on the street.

Harvey Finkle, Impact Visuals

Homelessness sometimes strikes entire families. This family is living in a donated tent on a vacant lot in Philadelphia.

Daily life is hard for the homeless, especially for those who are homeless for a long time. They may use such social services as overnight shelters, drop-in centers, and mobile services that deliver food and medicine. But homeless people still must face severe weather, lack of sleep, and threats to their personal safety. Other threats to their health include such chronic illnesses as tuberculosis and AIDS. Proper help for these problems, and especially a safe place in which to recover, are often difficult to find. Even healthy people who are homeless for a long period may become depressed and confused.

History. People have long experienced homelessness because of war, political unrest, fires, or such natural disasters as earthquakes, hurricanes, and floods. Since 1900, changes in the way people work and in the availability of jobs have been major causes of homelessness.

In the United States, homelessness has risen to crisis levels four times: just after the American Civil War ended in 1865, just before World War I began in 1914, during the Great Depression of the 1930's, and in the late 1900's. In the late 1860's, many Civil War veterans and freed slaves took advantage of the country's westward expansion and the new needs of industry by working as migrant farmworkers, lumberjacks, and railroad builders. They traveled from job to job and did not have a permanent home. In the early 1900's, workers in many jobs that required hard labor were replaced by machines. Workers who had held jobs in such industries as farming, lumbering, and freight handling sought new occupations in the cities, only to find few jobs available. As a result, many became poor and homeless. The Great Depression made even more people jobless and left 2 million to 3 million Americans without a home.

During World War II (1939-1945), many jobs were available, and the only homeless people were elderly or disabled. After the war, the economy grew, and even more jobs became available. People who were homeless stayed in the neglected urban areas known as *skid rows.* Most of these people were elderly, poor white men, many of whom had problems with alcohol abuse. Since the 1970's, the homeless population has changed and grown. Young people, women, and even families have experienced periods of homelessness. Many other homeless people are single men. Kim Hopper

See also **Children's home; Great Depression** (pictures); **Housing; Mental illness** (Treatment settings); **Poverty.**

Homeopathy, *HOH mee AHP uh thee,* is a system of medical practice based on the attempt to "let like cure like." According to homeopathic physicians, a substance that produces certain symptoms in a healthy individual will cure those symptoms in a sick individual. Poison ivy, for example, causes rashes. Homeopathic physicians thus treat rashes with poison ivy. Onions cause crying and a watery discharge from the nose. Therefore, onions are used to treat colds. Samuel Hahnemann, a German physician, developed homeopathy in the late 1700's (see **Hahnemann, Samuel**).

Homeopathic remedies are discovered through a process called *proving.* In proving, various substances are administered to healthy people and their effects carefully observed. Homeopathic physicians give pa-

tients only one remedy at a time. They believe that using combinations of remedies interferes with the effectiveness of each particular remedy. Remedies are diluted so that the patient receives the minimum effective dose. This procedure is thought to maximize the benefits of the treatment. It also helps prevent harmful side effects.

Many homeopathic remedies contain substances that could be toxic or hazardous to people if given in larger doses. In addition, the medical effectiveness of homeopathic treatments has not been scientifically proven. For these reasons, homeopathy has been criticized by many physicians. Thomas H. Maugh II

Homeostasis, *HOH mee uh STAY sihs,* is a term that refers to the ability of a living organism to maintain a stable set of conditions inside its body. In an animal, for example, such internal conditions as body temperature, blood pressure, and the composition of body fluids must remain relatively stable. A change in these internal conditions could result in disease or death.

To maintain homeostasis, an organism must react to its external environment by making internal adjustments. Such adjustments are triggered by *homeostatic reflexes.* An example of homeostatic reflexes occurs when a person steps outside on a hot day. If the body did not adjust to the heat, body temperature would go up so high that cells, especially brain cells, would die at a massive rate. However, homeostatic reflexes help maintain a constant internal body temperature. When the heat from the sun strikes the skin, nerve endings sense that heat and send a message to the brain. The brain sends nerve impulses that cause the blood vessels in the skin to expand. The resulting increase in blood flow to the skin produces greater heat loss from the skin surface. The brain also instructs the sweat glands to increase production, because the evaporation of sweat cools the skin. In addition, the brain initiates behavioral responses that make the person want to decrease physical activity and seek a cool place. Matthew J. Kluger

See also **Motivation** (Kinds of motives).

Homer is traditionally considered the ancient Greek poet who composed the great epics the *Iliad* and the *Odyssey.* Scholars know almost nothing about Homer. Some believe that he may have lived in a Greek-speaking city on the eastern shore of the Aegean Sea or on the island of Khíos. Other scholars deny that he ever existed. According to tradition, Homer was blind.

Homer's poems. The events in the *Iliad* and the *Odyssey* occur during and after the Trojan War. The legend of the war may be based on an actual war fought between Greece and the city of Troy in the mid-1200's B.C. Many scholars believe the poems were composed between 800 and 700 B.C. because the poems refer to social conditions at that time.

Roman copy of a marble sculpture by an unknown Greek artist; Ronald Sheridan

Homer

Archaeologists have discovered evidence in the ruins of Troy and ancient Greece that confirms the historical basis for some things described in the poems. But the poems' characters and events—even if partly based on real people and historical incidents—were altered over the centuries in the retelling of folk tales and in the poems of singing poets called *bards.* The bards created a series of poems that told the entire story of the Trojan War. The *Iliad* and the *Odyssey* are the only ones that survive, probably because of their long and sophisticated form.

After Homer's time, the two poems were recited as part of great religious festivals in Greece. Copies of the poems became the basic textbooks that Greek children used to learn to read and to study the legends and myths of ancient Greece. As a result, the Greeks formed their religious views from Homer's portrayals of the gods and goddesses. His poems also furnished characters and plots for the great tragic dramatists of the 400's B.C.—Aeschylus, Euripides, and Sophocles.

Early scholarship. The Greek people came to know Homer's poems by hearing them recited or by reading handwritten copies of them. In making copies, writers sometimes made mistakes or deliberate changes in the text. By 300 B.C., many slightly different versions of the *Iliad* and the *Odyssey* existed in Greece.

From about 300 B.C. to about 100 B.C., scholars at the great Alexandrian Library in Egypt tried to correct the changes in the two poems and restore them to their original form. A few of the scholars came to believe that the poems were the work of two different poets. These scholars, called *separatists,* thought that the language, point of view, and subject matter of the two poems differed so greatly that they could not have been created by one person.

Analysts and unitarians. For many centuries, the question of who composed the *Iliad* and the *Odyssey* was almost forgotten. Then, in 1795, German scholar Friedrich August Wolf revived the issue. He said archaeologists had no evidence that the Greeks knew how to write when Homer was supposed to have lived. Wolf argued that such long poems as the *Iliad* and the *Odyssey* could not have been composed without the knowledge of writing. He led a school of critics called *analysts,* who developed a theory that Homer never existed. They believed the *Iliad* and the *Odyssey* were collections of short songs by several poets. The analysts insisted that inconsistencies in the stories and variations in language showed many authors were involved.

A second group of scholars, who were called *unitarians,* opposed the analysts. The unitarians insisted that the *Iliad* and the *Odyssey* were the work of one poetic genius or, at most, of two great poets. The unitarians stressed the unified overall plan of the poems and the consistent character portrayals. The dispute between the analysts and the unitarians became known as the *Homeric question.*

The Homeric question today has been greatly influenced by our increased knowledge of how oral poetry is created. During the 1930's, an American scholar named Milman Parry began studying the bards of Yugoslavia. These bards were *illiterate* (unable to read or write), but they composed long poems orally. They did not memorize their poems, but re-created them in slightly different form at each recitation.

In creating their plots, the Yugoslav bards used and reused many traditional phrases, lines, and scenes. Parry pointed out that the *Iliad* and the *Odyssey* share these

characteristics, though on a much larger scale.

Parry's studies have been developed by other scholars into a theory that Homer was an illiterate bard of exceptional ability. According to this theory, Homer sang the stories of the *Iliad* and the *Odyssey* on many occasions. Toward the end of his life, writing was introduced into Greece. Homer then dictated the *Iliad* and the *Odyssey*. The poems were written in a form of Greek that does not belong to any one city or historical period. This fact has complicated scholars' attempts to trace Homer's life.

Most scholars today agree that the *Iliad* and the *Odyssey* reflect an oral tradition. But they still disagree over details of how the poems were composed or preserved.

Cynthia W. Shelmerdine

See also Iliad; Odyssey.

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Homer, Winslow (1836-1910), was an American artist. He became famous for paintings of the sea that are remarkable for their intensity of feeling and stirring grandeur. He never painted fishermen and sea captains as individuals, but as symbols of the rugged quality of all people who follow the sea. In the same way, Homer's vision of the sea is not local, but universal. Homer took American art out of the romanticism of the mid-1800's and carried it to the most powerful heights of realism.

Homer was born in Boston. He was apprenticed to a lithographer in 1854 and became a free-lance illustrator in 1857. By 1859, Homer was living in New York City. There he worked for *Harper's Weekly,* which employed him during the American Civil War (1861-1865) to illustrate battlefield scenes. Homer did many war illustrations. At the same time, he painted his first oils, which are scenes of farm and country life. He began painting water colors of these subjects in 1873.

Homer spent 10 months in Paris in 1867. He was not deeply influenced by his Paris stay, but his figure style was affected by the heroic peasants painted by the French artist Jean François Millet. A trip to the coastal town of Tynemouth, England, in 1881 and 1882 centered Homer's interest on the sea.

Returning to America, Homer settled permanently at Prout's Neck on the coast of Maine. Most of his sea paintings were done at Prout's Neck. Homer often traveled to the Adirondack Mountains and to Florida, Bermuda, and Nassau. He developed his water-color technique on these trips. He skillfully applied transparent *washes* (liquids) to instill a dramatic quality and fine feeling for light.

Sarah Burns

Homestead Act was passed by Congress in May 1862. It provided that any person over 21, who was the head of a family, and either a citizen or an alien who intended to become a citizen, could obtain the title to 160 acres (65 hectares) of public land if he or she lived on the land for five years and improved it. Or, the settler could obtain title by paying $1.25 per acre (0.4 hectare) if he or she had lived on the land for at least six months and made improvements on it.

The sponsors of this law thought that land was worthless before it was improved, and that people who converted unoccupied land into farms should not have to

Oil painting on canvas (1876); Gift of the W. L. and May T. Mellon Foundation © Board of Trustees, National Gallery of Art, Washington, D.C.

Winslow Homer's ***Breezing Up*** shows three boys and an adult sailing. The painting reflects two of the artist's main themes, vivid and dramatic images of the sea and nostalgic scenes of childhood.

pay for the land. They also hoped the law would help workers obtain *homesteads* (small farms) of their own.

Background. The demand that the government grant free land to settlers began during colonial times. After the Revolutionary War, the United States government regarded its public lands simply as a way of gaining money. This policy met with considerable opposition from farmers. They wanted the government at least to sell the land at a low price. In the 1840's and 1850's, the homestead movement became a national political issue. Proposals for a homestead law were often introduced in Congress. But questions of land policy became involved with the slavery issue, and most Southerners opposed the bills. When the Southern States seceded from the Union, passage of a homestead law became inevitable.

Effects of the law. The Homestead Act attracted thousands of settlers to the West. From 1862 until 1900, it provided farms and new homes for between 400,000 and 600,000 families. The opportunities offered by the act were widely advertised in America and Europe. On the whole, however, the act proved a disappointment to its friends. Through a series of other laws, Congress granted much of the best land in the West to railroad builders or to the states for the support of agricultural colleges. Workers were not attracted to the West.

Those who tried to develop homesteads in the West faced unexpected problems. They were not used to farming conditions on the plains. Farmers often had to use irrigation because rainfall was scarce. The development of farm machinery made a farm of only 160 acres (65 hectares) uneconomical. Some homesteaders sold their land to speculators because of the many problems.

Beginning in 1873, Congress passed a series of new measures that modified the act of 1862. These measures allowed the people to acquire larger tracts of land. But the chief beneficiaries were speculators and others who sought control of the natural resources of the West. Some historians question the value of the act because of the widespread abuses. Of the public lands that passed into private hands from 1862 to 1900, not more than 11 to 17 percent was settled by homesteaders.

Much of the homesteading during the 1900's took place in Alaska. Many homesteaders acquired free land in the Anchorage area. The U.S. government ended the homesteading program in 1976 for all states except Alaska. The Homestead Act expired in Alaska in 1986.

Jerome O. Steffen

See also **Pre-emption; Public lands; Western frontier life in America; Westward movement in America.**

Homestead Strike of 1892 showed the power of American big business and was a major defeat for the union movement. The strike involved the Amalgamated Association of Iron and Steel and the Carnegie Steel Company. The union called the strike on June 29, 1892, at Homestead, Pa., because of a wage cut. The company hired private detectives as guards. A battle between workers and guards resulted in several deaths and many injuries. After peace was restored, most of the workers quit the union and went back to work. See also **Carnegie, Andrew** (The Homestead Strike); **Goldman, Emma.**

David Brody

Homicide is the killing of one person by another. Homicide includes an excusable or justifiable killing, as well as murder and manslaughter. A person who finds a burglar attempting to force a way into his or her home sometimes has a legal right to shoot the burglar in self-defense or to prevent the crime. But the killing is still a homicide. If a child dashes in front of a truck and gets killed, the truck driver may be entirely blameless, but the driver has nevertheless committed a homicide. When a person who kills another is found to have acted within his or her rights, the killing is considered a *justifiable homicide.* Justifiable homicide includes killing a person to prevent the commission of a felony by force. Courts also consider homicide in self-defense justifiable. All other homicides are punishable as murder or manslaughter.

Charles F. Wellford

See also **Manslaughter; Murder.**

Homing pigeon is a special type of pigeon developed for racing and carrying messages. These pigeons are sometimes called *homers.* They can be trained to return to their home loft when released from a distant place. This homing ability has been greatly increased by selective breeding. Homers are descended from the rock pigeon that lives wild in Europe, Asia, and Africa.

The homing ability. No one knows exactly how pigeons and other birds find their way across strange territory to reach home. Homing pigeons have been known to fly more than 1,000 miles (1,600 kilometers) in two days. This would not allow much time for random searching, so they somehow know the proper direction to take. Some people believe these birds have a mysterious ability to orient themselves with the earth's magnetic field. But there is no real proof of this. Others think the birds are guided by the position of the sun. Just how they do this is not clear, but birds may lose their way in cloudy or foggy weather. Homing pigeons have a highly developed ability to recall visible landmarks. However, this does not explain their homing over unfamiliar country.

Pigeon racing. Many people enjoy racing homing pigeons and organize races that cover up to 600 miles (970 kilometers). Additional training of individual birds is important. Trainers first allow the young pigeons to become familiar with the area near the home loft. Then they take the birds 5 to 10 miles (8 to 16 kilometers) away and release them. The trainers gradually increase the

Hans Reinhard, Bruce Coleman Ltd

Homing pigeons carry messages in a holder attached to the leg or back. They can fly up to 60 miles (97 kilometers) an hour.

distance that the bird must fly to reach its home loft.

If the birds are to be raced, the owner trains them over the area in which the race is to be held. Only the most successful homers are entered in competitions. The trainer chooses birds that are in the finest physical condition and have perfect, unbroken flight feathers. Some birds have flown 600 miles (970 kilometers) in one day, without stopping to eat or drink. Pigeons two or three years old make the speediest racers. But older birds perform better in bad weather. Birds with young in the nest are especially dependable homers. Their concern for the young makes them anxious to return.

In official races, clocking devices record the time at which the birds reach their home loft. Upon reaching home, the bird must enter the loft at once so that the owner can remove its band and record the time.

History. Homing pigeons carried messages for the ancient Egyptians and Persians 3,000 years ago. In Greece, pigeons carried news of Olympic Games victories to the different cities. The Romans used them to send military messages. During the Franco-Prussian War, the French used homing pigeons, and the Germans trained hawks to catch them. Homing pigeons served the United States Signal Corps in World Wars I and II and in the Korean War. During World War I, one bird carried a message about 24 miles (39 kilometers) in 25 minutes. It arrived with one leg shot off and its breast injured by a bullet. In 1956, the U.S. Army sold the last of its homing pigeons. They have been replaced by electronic devices. Donald F. Bruning

See also **Pigeon** (picture); **Reuter, Baron de.**

Hominy, *HAHM uh nee,* is a food made from hulled corn. The corn is soaked in a weak lye solution. This causes the kernels to puff up. The skins come free and float to the top. After the kernels are washed, they are ready to be cooked. Hominy has been a favorite dish in the Southern United States since pioneer days. It may be boiled or fried, and is usually served with meat. Ground hominy is called *grits.* Donald J. Reid

Homo erectus, *HOH moh ih REHK tuhs,* is regarded by most anthropologists as a species of human being that lived from about 1,800,000 to 300,000 years ago. *Homo erectus* resembled people of today but had a slightly smaller brain and slightly larger teeth. *Homo erectus* stood over 5 feet (150 centimeters) tall and walked upright. The Latin word *homo* means *human being. Erectus* means *upright* and refers to the creature's erect posture.

Homo erectus made stone tools, including axes. These early people were probably the first human beings to master the use of fire. They originated in Africa and became the first people to migrate from that continent, eventually reaching northern Asia and Europe.

Fossils of *Homo erectus* were first found in 1891 in Java, which is now part of Indonesia (see **Java fossils**). Others were found near Beijing (also called Peking), China (see **Peking fossils**).

In 1984, two almost complete *Homo erectus* skeletons were found. One was uncovered at Lake Turkana in Kenya. The bones were about 1 $\frac{1}{2}$ million years old, one of the oldest *Homo erectus* specimens ever found. The lack of adult teeth indicated that the person died at about the age of 12. The size of the thighbone suggested that the person was already about 5 $\frac{1}{2}$ feet (168 centimeters) tall. This skeleton, which lacked some bones from the arms and feet, is the most complete skeleton of an early ancestor ever found. The other skeleton found in 1984 was uncovered in northeastern China. It lacked arm and leg bones and was about 300,000 years old. These discoveries gave scientists their first opportunity to study bones from all parts of the skeleton instead of just teeth and the skull.

Many scientists think *Homo erectus* developed from a type of prehistoric human being known as *Homo habilis* (skillful human being). They also believe *Homo erectus* was an ancestor of our own species, which is called *Homo sapiens* (wise human being). Adrienne L. Zihlman

See also **Prehistoric people** (Three species; picture).

Homo habilis, *HOH moh HAB uh luhs,* is considered by many anthropologists to be the oldest type of human being. Fossil evidence indicates that these prehistoric people lived in Africa about 2 million years ago. The Latin word *homo* means *human being. Habilis* means *skillful* or *handy.* Scientists gave *Homo habilis* this name because its fossils have been found along with some of the earliest-known stone tools. The findings suggest that *Homo habilis* made the tools.

Some anthropologists believe that another species of early human being, *Homo rudolfensis,* lived in eastern Africa at the same time as *Homo habilis.* These scientists think *Homo rudolfensis* differed from *Homo habilis* in having a larger brain, larger rear chewing teeth, and perhaps a larger body. Other anthropologists believe that fossils identified as belonging to *Homo rudolfensis* are actually those of *Homo habilis* males.

The first *Homo habilis* fossils were found at Olduvai Gorge in Tanzania in 1960. Other *Homo habilis* fossils were found at Lake Turkana in Kenya and at other sites in eastern and southern Africa. Some scientists believe the oldest-known *Homo habilis* fossil is part of the skull of a person who lived about 1,900,000 years ago. The fossil was found at Lake Turkana in 1972. Other scientists believe this fossil belongs to *Homo rudolfensis.*

The arm bones of *Homo habilis* were relatively long compared with the thighbones. Thus, some scientists think *Homo habilis,* like apes, spent a lot of time in trees.

Many anthropologists believe that *Homo habilis* developed from humanlike creatures called *australopithecines. Homo habilis* had a brain larger than that of an australopithecine but only a little more than half the size of a modern human brain. Many scientists believe that *Homo habilis,* in turn, developed into a more advanced type of prehistoric human being known as *Homo erectus* (erect human being). *Homo erectus* appeared in eastern Africa about 1 $\frac{1}{2}$ million years ago. Andrew Hill

See also **Australopithecus; Homo erectus; Leakey, Louis Seymour Bazett; Leakey, Richard Erskine Frere; Prehistoric people** (The first human beings).

Homo sapiens. See **Prehistoric people** (The development of *Homo sapiens*).

Homologous structures, *hoh MAHL uh guhs,* are structures that have an essential similarity and develop in the same general way. For example, the flipper of a seal and the foreleg of a dog have the same basic structure. The legs of a turtle and the wings of a bird are also homologous, but they have different uses. Organs that have similar uses but that are not similar in structure are said to be *analogous.* For example, the wings of birds

and the wings of insects are analogous structures.

Homonym, *HAHM uh nihm,* is a word having the same spelling and pronunciation as another word or words, but a different meaning. Examples are *bark* (of a dog) and *bark* (of a tree); and *rest* (relief from activity) and *rest* (remainder). Some linguists include *homophones* in their definition of homonyms. Homophones are words with the same pronunciation but different spellings and meanings *(site, cite, sight; ate, eight).* In addition, some linguists include *heteronyms* in their definition of homonyms (see **Heteronym**). Sara Garnes

Homosexuality is sexual attraction chiefly to individuals of the same sex. People—especially men—who are homosexual are also called *gay.* Many female homosexuals call themselves *lesbians.* Scientists are not sure how many people are homosexual. Since the late 1940's, various estimates suggest that 1 to 10 percent of men and women are attracted chiefly to people of their own sex.

Some people are not entirely homosexual or *heterosexual* (sexually attracted chiefly to the other sex). Some individuals have homosexual experiences but marry people of the other sex and have children. Many people who consider themselves heterosexual have participated in homosexual acts at some time in their lives. People who are strongly attracted to members of both sexes are called *bisexual.* A person's primary sexual attraction is also called *sexual orientation.*

Young people may explore their sexual development with members of their own sex. For example, many young people *masturbate* (pleasurably handle their own sex organs). Boys may sometimes handle the sex organs of other boys. Girls may also stimulate each other. Such activity rarely develops into a homosexual orientation.

Some homosexual behavior results from unavailability of the other sex. For example, people in prison who spend long periods separated from the other sex may turn to same-sex partners. Such homosexual interest may not continue once other partners become available.

The causes of sexual orientation are not fully understood. Some experts believe all people are born with a potential to be bisexual. But most people develop a strong attraction primarily for sexual partners of one sex.

Most experts think that a number of factors can influence sexual orientation. Some researchers believe that sexual orientation results chiefly from biological factors. One such factor may be the effect of hormones on the developing brain of a fetus before birth. Some scientists also think particular *genes* (units of heredity) may be involved. Other researchers believe that sexual orientation is determined primarily by social and psychological factors. According to one theory, children learn through pleasurable sexual experiences to become increasingly attracted to one of the sexes or to both sexes.

Attitudes toward homosexuality. Homosexuality has existed in most societies throughout history. Various cultures have differed in their attitudes toward same-sex relationships. For example, some people of ancient Greece not only accepted male homosexual relationships but considered a partnership between a young man and an older man ideal. Men of ancient Greece may have idealized homosexuality because they believed that only another male could fulfill the role of true friend and lover. Other cultures have permitted homosexuality but have not encouraged it. Still others have forbidden it, and some have punished homosexuals.

Today, political, religious, and personal attitudes about homosexuality vary throughout the world. Some people try to change their homosexual orientation through psychotherapy. But many experts believe that learning to accept one's feelings and to create a satisfying life may be more realistic goals. Some gay men and women hide their homosexuality, but others are more open about it. Many join gay or lesbian groups. Sometimes two homosexuals establish a long-term relationship that is similar to marriage.

In some countries and some states of the United States, homosexual acts are illegal. Other nations, including Canada, France, the Netherlands, and the United Kingdom, have no laws against homosexual acts between consenting adults. Some countries grant long-term gay partnerships the same legal rights as marriage.

Many medical and legal professionals and social scientists oppose laws that prohibit or punish homosexuality. They believe such laws penalize homosexuals unfairly for ways of life that do not directly affect others.

An effort to win full civil rights for homosexuals—often called the *gay rights movement*—arose during the 1950's in Europe and North America. In 1961, Illinois became the first U.S. state to abolish its laws against private homosexual acts. In 1969, a group of male homosexuals resisted arrest at a gay bar in New York City called the Stonewall Inn. After this resistance—commonly known as Stonewall—the gay rights movement grew rapidly.

Since 1970, several U.S. states and a number of U.S. and Canadian cities have passed laws banning discrimination against homosexuals. These laws forbid discrimination in employment, in housing, and in other activities. A growing number of employers also grant the same benefits to same-sex "domestic partnerships" as to conventional marriages.

During the 1980's, however, the gay rights movement suffered a setback as the AIDS epidemic swept Europe and North America. In those regions, the disease first occurred mainly among gay men. Although AIDS also occurs among—and is transmitted by—heterosexual men and women, many people blamed homosexuals for its spread. Many homosexuals feared increased discrimination as a result of the AIDS crisis. See **AIDS.**

In 1986, the Supreme Court of the United States ruled in *Bowers v. Hardwick* that states could enact laws forbidding private homosexual acts. Such laws are rarely enforced, but gay leaders feel that these laws express society's disapproval of homosexuality.

In 1996, the U.S. Supreme Court ruled in *Romer v. Evans* that states may not ban laws that protect homosexuals against discrimination. Gay activists hailed this ruling as a victory for gay rights. In 2000, Vermont passed a law that grants same-sex couples living in civil unions the same legal rights and responsibilities as married couples in the state. Martin S. Weinberg

See also **Adolescent** (Establishing a sexual identity); **Sexuality.**

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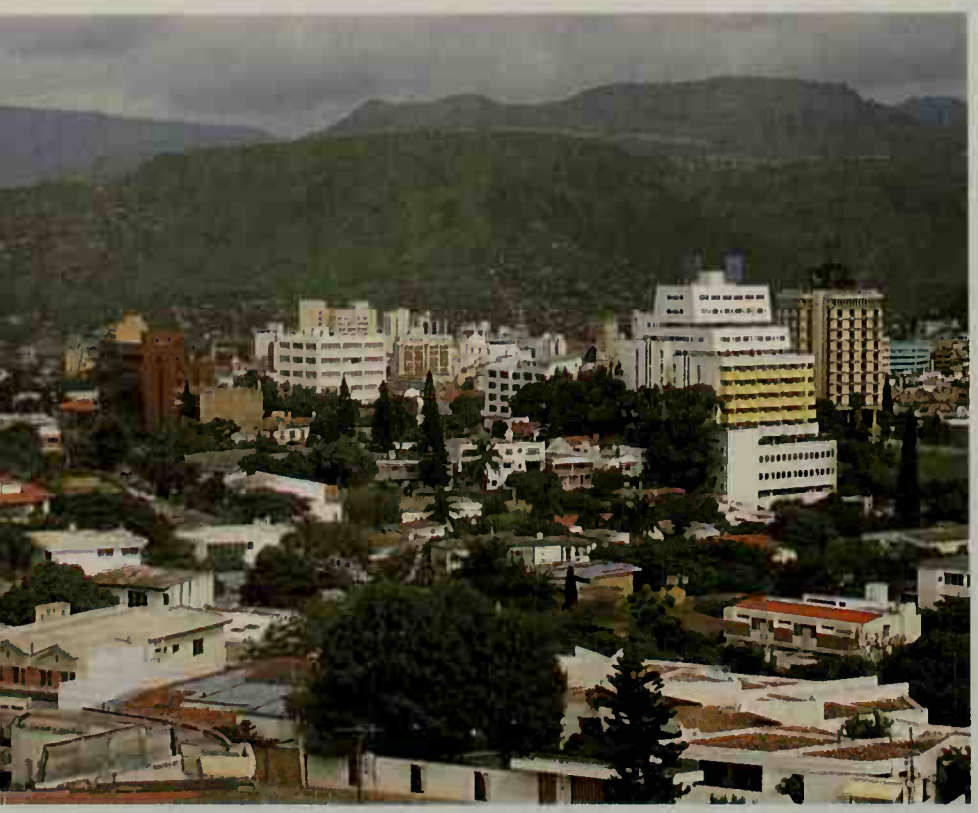


Miguel Reyes, Latin Focus

Tegucigalpa, the capital and largest city of Honduras, lies among the mountains in the south-central part of the country.

Miguel Reyes, Latin Focus

Bananas, Honduras's chief product, are grown along the northern coast.

Honduras

Honduras, *hahn DOO ruhs,* is a small Central American country that is known for the production of bananas. Honduras is a poor country. Its people have a low average income.

Bananas are Honduras's leading source of income. They are grown in the northern lowlands along the Caribbean Sea. In the inland mountains, many people raise beans, cattle, coffee, and corn. Tegucigalpa, the capital and largest city of Honduras, is located in this region. The country has limited transportation, and Tegucigalpa is one of the few capitals in the world with no railroad. Hondurans raise cattle and cotton on the plains bordering the Pacific Ocean in the southern part of the country.

The Italian explorer Christopher Columbus arrived at Honduras in 1502. Columbus or a later explorer called the land *Honduras,* the Spanish word for *depths,* because of the deep waters off the northern coast of the country.

Government

The president is the head of the government of Honduras. The people elect the president to a four-year term. The president may serve only one term. The president appoints a Cabinet to help in carrying out the day-to-day operations of the government.

The National Congress is the country's legislature. The 128 members of the congress are elected to four-year terms. The Supreme Court of Justice is the country's highest court.

Through the years, the military has had much influence in the government of Honduras. For example, the country's military leaders can veto any of the president's

Gary S. Elbow, the contributor of this article, is Professor of Geography at Texas Tech University.

Facts in brief

Capital: Tegucigalpa.
Official language: Spanish.
Area: 43,277 mi² (112,088 km²). *Greatest distances*—east-west, 405 mi (652 km); north-south, 240 mi (386 km). *Coastlines*—Caribbean, 382 mi (615 km); Pacific, 48 mi (77 km).
Elevation: *Highest*—Cerro Las Minas, 9,347 ft (2,849 m) above sea level. *Lowest*—sea level along the coasts.
Population: *Estimated 2002 population*—6,812,000; density, 157 per mi² (61 per km²); distribution, 55 percent rural, 45 percent urban. *1988 census*—4,248,561.
Chief products: *Agriculture*—bananas, beans, beef and dairy cattle, coffee, corn, cotton, milk, sugar cane, rice, tobacco. *Manufacturing*—clothing and textiles, cigarettes, lumber, processed foods and beverages. *Mining*—lead, silver, zinc.
National holiday: Independence Day, September 15.
National anthem: "Himno Nacional de Honduras" ("National Hymn of Honduras").
Money: *Basic unit*—lempira. One hundred centavos equal one lempira.

appointments to the Cabinet. Military leaders in Honduras have often taken complete control of the government. See the *History* section of this article for details of the military's role in the Honduran government.

People

Most rural Hondurans are poor peasants who own or rent small farms. These people have poor transportation and communication and are cut off from the life of the cities.

Modernizing changes are taking place in the cities because of expanding industry and education. However, such changes are only slowly reaching rural areas. Most rural Hondurans live in small houses made of adobe, boards, or poles, or of dirt and stones packed into a wooden frame.

Tegucigalpa, the capital, is also Honduras's largest city. Other large cities include El Progreso, La Ceiba, and San Pedro Sula.

Ancestry. More than 90 percent of all Hondurans are *mestizos* (people of both white and Indian ancestry). Almost all mestizos speak Spanish and are Roman Catholics. In the northern banana-growing areas and port cities, many people can speak English. They learned English because U.S. fruit companies have long done business there.

More than 70,000 Miskito Indians live in thinly populated northeastern Honduras. This group is a mixture of native Indians, freed black slaves, and other groups. They speak the Miskito language. All of the Miskito Indians are Christians, and many belong to the Moravian Church, a Protestant sect.

Garifuna, or Black Carib, dwell along the northwestern coast of Honduras. These people are descended from black slaves and Arawak Indians on the Caribbean island of St. Vincent. In 1797, the British rulers of St. Vincent transported people to Honduras because they were considered rebellious. The Garifuna speak an Arawak language, but most also speak Spanish, English, or both. About 80,000 Garifuna live in Honduras.

The people of the Bay Islands, which lie off the northern coast, are mostly English-speaking Protestants. These people include descendants of Garifuna, of English planters, and of freed black slaves who emigrated from the Cayman Islands in the Caribbean during the 1800's.

Education. Honduran law requires children to go to school from the age of 7 through 12, but many do not do so. Honduras does not have enough schools, especially in the rural areas. The country's largest university, the National Autonomous University of Honduras, was founded in Tegucigalpa in 1847. It has a branch campus in San Pedro Sula. The Pan American Agricultural School, founded by the U.S. company Chiquita Brands International, is near the capital. For Honduras's literacy rate, see **Literacy** (table: Literacy rates for selected countries).

The land

Honduras has four main land regions: (1) the Mountainous Interior, (2) the Northern Coast, (3) the Northeastern Plain, and (4) the Southern Coast.

The Mountainous Interior covers more than 60 percent of Honduras. The country's highest point is 9,347 feet (2,849 meters) above sea level in the Cerros de Celaque, a mountain range, but most Honduran mountains are much lower.

Forests of oaks and pines cover slopes below 7,000 feet (2,100 meters). Above the height of the oak and pine forests are forests of broadleaf evergreens or, where these *cloud forests* have been cut down, patches of scrub pines.

Honduras has no live volcanoes, though neighboring countries do. As a result, Honduras lacks soils made especially fertile by volcanic ash. But a number of small upland valleys in the Mountainous Interior have rich soils that support many farmers, particularly in the western and central parts of the region.

The Northern Coast is the banana-producing region of Honduras. The most important banana areas are the fertile Ulua-Chamelecón River Basin and the coastal plain near the port of Tela. San Pedro Sula, the second largest city in Honduras, is the region's major commercial center. Nearby Puerto Cortés is the country's leading port.

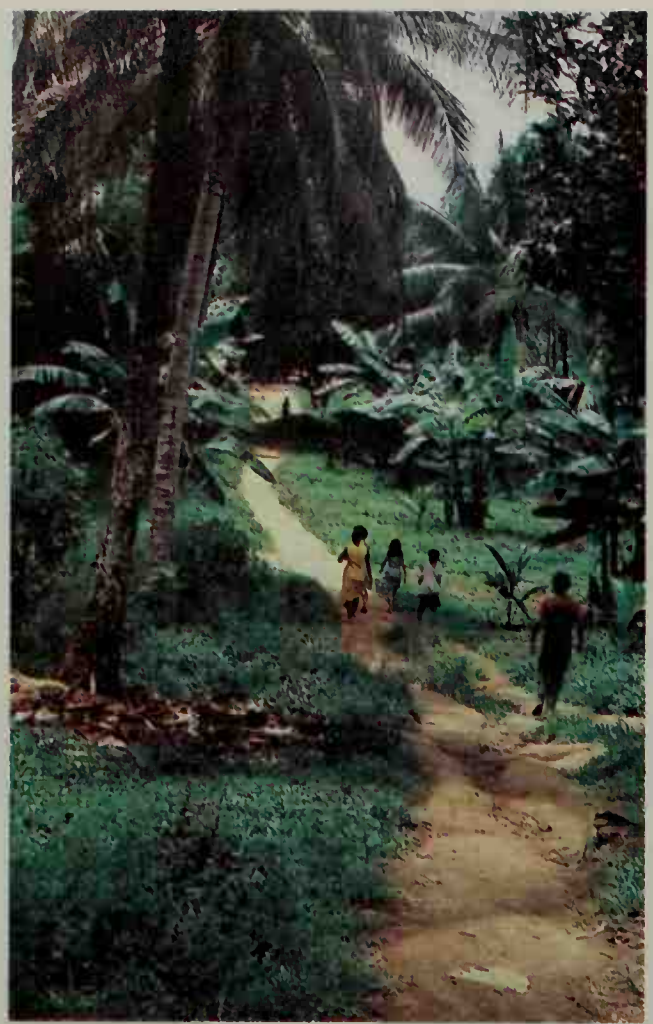
The Northern Coast has the only railroads in Honduras. The railroads, built chiefly to carry bananas from plantations to the ports, extend only about 65 miles (105 kilometers) inland.

The flag of Honduras was adopted in 1866. The stars represent five Central American republics that formed a union in the early 1800's.

The coat of arms describes Honduras as *Free, Sovereign, and Independent,* and shows the date of the nation's independence—Sept. 15, 1821.

WORLD BOOK map

Honduras is bordered by Nicaragua, the Pacific Ocean, El Salvador, Guatemala, and the Caribbean Sea.



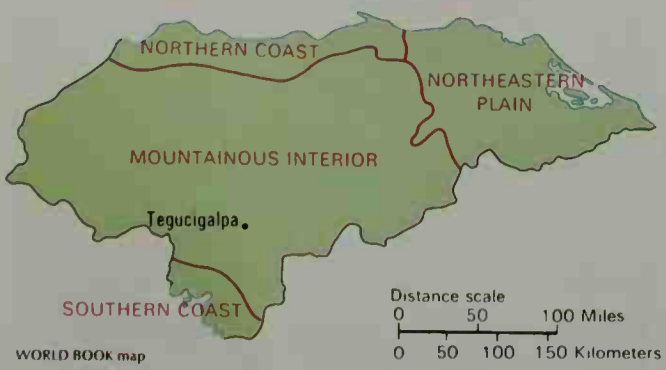
© Nancy McGirr

The Mosquito Coast of northeastern Honduras is covered mostly by tropical rain forests. However, small towns are scattered throughout the area.

East of Tela, the region is largely undeveloped and sparsely populated. It consists of grasslands, swamps, and palm and pine forests. There is some farming in the Aguán Valley and other river valleys.

The Northeastern Plain is the least developed and most thinly populated region of Honduras. It has some small Indian communities and a few little towns. Tropical rain forests cover much of the region. They make up a hot, wet area called the Mosquito Coast, or Mosquitia.

Land regions of Honduras



The plain also has grasslands and some forests of pine and palm trees.

The country's border with Nicaragua was disputed until 1960. The International Court of Justice in the Netherlands decided in favor of the Honduran claim, and the border was established at the Coco, or Wanks, River. Honduras also owns the Swan Islands, two small islands about 125 miles (201 kilometers) to the north in the Caribbean Sea.

The Southern Coast, on the Gulf of Fonseca, is Honduras' only outlet to the Pacific Ocean. Mangrove trees grow along the shoreline, behind which lie narrow plains. The largest plain, that of the Choluteca River in the Choluteca *department* (administrative district), has rich soils that support many farms and cattle ranches. San Lorenzo is the chief port on the Southern Coast.

Climate

Honduras has a tropical climate that becomes cooler in the mountains with the increase of altitude. The coastal lowlands have an average yearly temperature of 88 °F (31 °C), with little seasonal change. Tegucigalpa, 3,070 feet (936 meters) above sea level, has an average of 74 °F (23 °C). The capital's temperature rarely rises above 90 °F (32 °C) in May, the warmest month, and seldom falls below 50 °F (10 °C) in December, the coolest month. The highland areas have mild temperatures.

The rainy season begins in May. It ends by November or December in the southern and central highlands, which receive a yearly average of 30 to 60 inches (76 to 152 centimeters) of rain. The rain falls until February in the north, and almost throughout the year in the northeast. That region of tropical rain forests, the wettest part of Honduras, has more than 100 inches (250 centimeters) of rain a year. Hurricanes sometimes hit the Northern Coast and damage crops.

Economy

Honduras has few resources, and its economy is one of the most underdeveloped in Latin America. Agriculture is by far the most important economic activity in Honduras. Much of the country's income is from banana

© Bob Daemmrich

The Mountainous Interior of Honduras includes thick forests of oaks and evergreens. The picture above shows an area in the department of El Paraíso, in south-central Honduras.

Honduras map index

Departments*

Atlántida	238,741	B	3
Choluteca	295,484	E	3
Colón	149,677	B	4
Comayagua	239,859	C	3
Copán	219,455	C	1
Cortés	662,772	B	2
El Paraíso	254,295	D	4
Francisco Morazán	828,274	C	3
Gracias a Dios	34,970	B	6
Intibucá	124,681	C	2
Islas de la Bahía	22,062	A	4
La Paz	105,927	C	2
Lempira	177,055	C	1
Ocotepeque	74,276	C	1
Olancho	283,852	C	4
Santa Bárbara	278,868	B	2
Valle	119,965	D	3
Yoro	333,508	B	3

Cities and towns

Ajuterique*	3,734	C	3
Amapala	2,422	E	2
Arada*	2,574	C	2
Azacualpa	5,139	B	1
Bonito Oriental*	2,795	B	5
Brus Laguna*	1,791	B	6
Campamento*	4,253	C	4
Cane*	1,710	C	2
Catacamas	17,965	C	4
Choloma	39,054	B	2
Choluteca	54,481	E	3
Comayagua	37,226	C	2
Copán	4,241	C	1
Corquín*	3,391	C	1
Danlí	29,025	D	4
Dulce Nombre*	3,013	C	1
Dulce Nombre de Culmí	1,964	B	5
El Negrito*	5,099	B	2
El Níspero	2,453	C	2
El Paraíso* (Copán)	3,333	B	1
El Paraíso (El Paraíso)	13,069	D	4
El Porvenir*	2,754	D	3
El Progreso	60,058	B	2
El Rosario*	1,843	C	2
El Triunfo*	4,670	E	3
Florida*	4,640	B	1
Gracias	3,854	C	1
Guaimaca	6,289	C	3
Gualaco	1,971	B	4
Guanaja*	2,027	A	4
Güinope*	1,912	D	3
Intibucá*	7,241	C	2
Iriona	8,473	A	5
Jacaleapa*	1,158	D	4
Jesús de Otoro*	4,361	C	2
Jocón	1,235	B	3
Jutiapa*	1,658	A	4
Juticalpa	19,622	C	4
La Ceiba	68,764	B	3
La Esperanza	4,017	C	2
La Libertad*	3,602	C	2
La Masica*	2,855	B	3
Langue*	2,921	D	2
La Paz	11,238	C	2
La Pimienta	3,290	B	2
La Unión*	2,220	C	2
Lejamaní*	2,862	C	1
Limón	2,174	A	5
Macuelizo*	2,456	B	1
Marcala	5,488	D	2
Minas de Oro*	2,937	C	3
Morazán	7,463	B	2
Nacaome	9,801	D	3
Naranjito*	3,891	C	1
Nueva Arcadia	8,943	B	1
Nueva Ocotepeque	6,979	C	1
Olanchito	13,969	B	4
Orica*	2,050	C	4
Pespire	2,197	D	3
Potrerillos	8,913	B	2
Puerto Cortés	31,586	A	2
Puerto Lempira	2,033	B	7
Quimistán	2,455	B	2
Roatán	3,901	A	4
Saba*	4,929	B	4
Sabanagrande	1,818	D	3
Salamá	2,360	C	3
San Antonio de Cortés	3,259	B	2
San Esteban	1,605	B	7
San Francisco*	2,936	B	2
San Francisco de Becerra*	2,060	C	3
San Francisco de la Paz*	4,344	C	4
San Ignacio	2,323	C	3
San José de Colinas*	3,536	B	1
San Juan de Flores*	2,305	D	3
San Lorenzo	15,603	D	3
San Luis*	3,536	B	2
San Manuel*	3,563	B	2
San Marcos de Colón	6,900	D	3
San Nicolás* (Copán)	1,996	C	1
San Nicolás (Santa Bárbara)	2,612	B	2
San Pedro Sula	326,943	B	2
Santa Bárbara	10,503	C	2
Santa Cruz de Yojoa	5,144	C	2
Santa María de el Real*	2,872	C	4
Santa Rita	9,518	B	2
Santa Rosa de Aguán*	1,658	A	5
Santa Rosa de Copán	19,680	C	1
Siguatepeque	27,293	C	2
Sonaguera	4,596	B	4
Talanga	9,062	C	3
Tegucigalpa	624,542	D	3
Tela	23,303	B	3
Teupasenti*	3,631	C	4
Tocoa	14,079	B	4
Trinidad* (Copán)	1,970	B	1
Trinidad (Santa Bárbara)	3,501	B	2
Trujillo	5,783	A	4
Victoria*	2,585	C	3
Villa de San Antonio*	3,741	C	2
Villa de San Francisco*	4,254	D	3
Villanueva	11,981	B	2
Yoro	9,416	B	3
Yuscarán	2,091	D	3
Zacapa	841	C	2

Physical features

Aguán (river)		B	4
Bahía, Islas de la (islands)		A	4
Bay Islands, see Bahía, Islas de la			
Bay of Tela		A	3
Cabo Camarón (cape)		A	5
Cabo de Honduras (cape)		A	4
Caribbean Sea		A	6
Cerros de Celaque (mountains)		C	1
Cerro Las Minas (peak)		C	1
Chamelecón (river)		B	1
Choluteca (river)		D	3
Coco (Wanks) (river)		C	7
Copán (ruin)		C	1
Cordillera Entre Ríos (mountains)		C	5
Cordillera Nombre de Dios (mountains)		B	3
Guanaja, Isla de (island)		A	4
Guayape (river)		C	4
Gulf of Fonesca		E	3
Gulf of Honduras		A	2
Jalán (river)		C	4
Laguna de Brus (lagoon)		B	6
Laguna de Caratasca (lagoon)		B	7
Lake Yojoa		C	2
Montañas de Colón (mountains)		C	5
Montañas de Comayagua (mountains)		C	5
Montañas del Patuca (mountains)		C	5
Mosquito Coast		B	7
Negro (river)		E	3
Patuca (river)		C	5
Pico Bonito (peak)		B	3
Punta Patuca (point)		A	6
Punta Sal (point)		A	2
Roatan, Isla de (island)		A	4
Salitron (ruin)		C	2
Sierra de la Esperanza (mountains)		B	4
Sico (river)		B	5
Tenampua (ruin)		C	3
Ulua (river)		B	2
Utila, Isla de (island)		B	3

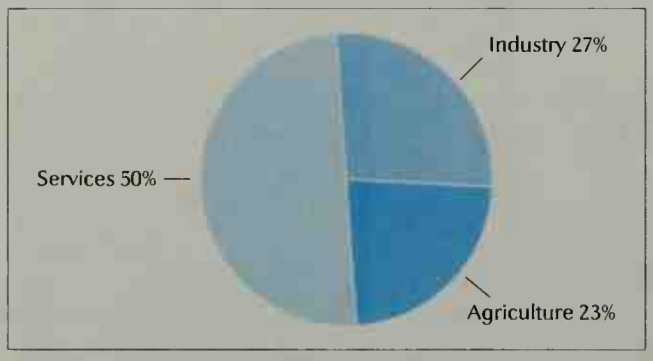
*Does not appear on map; key shows general location.
Sources: 1988 census.

and coffee exports. The banana industry in Honduras was developed by United States companies during the early 1900's. Today, most of the banana plantations are owned by Honduran companies. However, the firms that ship the bananas to foreign markets are mostly foreign-owned.

Agriculture employs more Honduran workers than any other economic activity. Bananas account for about a third of Honduras's exports, and coffee accounts for about a fifth. Corn is the people's main food. The corn crop covers more land than any other crop in Honduras. Farmers also grow beans, cotton, rice, sugar cane, and tobacco. Beef and dairy cattle are raised in the highland valleys and southern grasslands.

Honduras exports shrimp, which are caught near the Bay Islands. Honduras also exports timber from pines and tropical hardwood trees. Beef is also an important export.

Gross domestic product of Honduras



The gross domestic product (GDP) of Honduras was $4,079,600,000 in 1996. The GDP is the total value of goods and services produced within a country in a year. *Services* include community, business, and personal services; finance, insurance, and real estate; government; transportation, communication, and utilities; and wholesale and retail trade. *Industry* includes construction, manufacturing, and mining. *Agriculture* includes agriculture, forestry, and fishing.

Production and workers by economic activities

Economic activities	Percent of GDP produced	Employed workers	
		Number of people	Percent of total
Agriculture, forestry, & fishing	23	760,100	38
Manufacturing	19	352,400	18
Wholesale & retail trade	13	345,700	17
Community, business, & personal services	11	351,400	18
Transportation, communication, & utilities	10	50,900	3
Finance, insurance, & real estate	10	40,900	2
Construction	6	80,500	4
Government	6	*	*
Mining	2	3,000	†
Total	100	1,984,900	100

*Included in Community, business, and personal services.
†Less than one-half of 1 percent.
Figures are for 1996.
Sources: Central Bank of Honduras; International Labour Office.

Service industries. Wholesale and retail trade is Honduras's most important service industry in terms of the gross domestic product. Much of the country's trade industry is based on the distribution of agricultural products. Community, business, and personal services form the second most important category of service industry. This industry includes various services, such as education and health care. These services are most important in the country's largest cities, especially Tegucigalpa.

Manufacturing. Products manufactured in Honduras consist largely of cigarettes, clothing, processed foods and beverages, and textiles. Sawmills provide much lumber for the furniture, paper, and wood products industries. Tegucigalpa and San Pedro Sula are the major manufacturing centers. Pottery articles, used widely in Honduran households, are made in rural homes as a craft industry. Honduras imports most of its machinery and other manufactured goods from the United States, its major trading partner, and from other countries.

Transportation. Roads in Honduras are scarce and few are paved, especially in the rural areas. There, the people travel mainly by buses, mules, or horses. Less than 2 percent of the people own an automobile. Honduran railways—operated mostly by the fruit companies—serve only the Northern Coast region. The country has two international airports, at Tegucigalpa and San Pedro Sula.

Communication. Honduras has four daily newspapers. The largest is *La Tribuna* of Tegucigalpa. Most of the radio and television stations are privately owned. Honduras has an average of about one radio for every three people and one television set for every 14 people. Almost all the telephone lines in the country are owned by the government and are in Tegucigalpa and San Pedro Sula.

History

The Indian period. Little is known of what is now Honduras before the arrival of the Spaniards in the early 1500's. An eastern center of the famous Maya Indian civilization had thrived at Copán until the 800's. Copán featured beautiful stone palaces, pyramids, and temples, and its people were advanced in science and other learning. But by the time the Spaniards arrived, Copán lay in ruins, and the Indians of the region had forgotten the city.

The colonial period. In 1502, Christopher Columbus landed at Cabo de Honduras (Cape Honduras). He claimed the land for Spain. A number of Spanish explorers soon visited the region and founded settlements. The Spaniards gradually conquered the Indians. Many Indians were killed, died of disease, or were shipped as slaves to plantations in the West Indies.

The Spaniards developed gold and silver mines in Honduras. They brought many black slaves from Africa to work in the mines along with the Indians. The Spaniards also developed cattle ranches to supply food to the mining centers. But the mines were not profitable enough to attract many colonists.

Independence. On Sept. 15, 1821, Honduras and four other Central American states declared their independence from Spain. They became part of the Mexican empire, but they broke away from it in 1823 and formed

the United Provinces of Central America. This union generally followed liberal policies. It established some civil rights and ended the special privileges of the powerful nobility and the Roman Catholic Church. Honduras left the union in 1838 after the union began to fall apart under various pressures, including efforts by landowners and the clergy to regain their privileges.

Honduras was the weakest country in Central America. It soon came under the influence of its more powerful neighbors, especially Guatemala. During the 1800's, Guatemala started or aided several revolts in Honduras. It supported either Honduran conservatives or liberals, depending on which group was in power in Guatemala.

United States fruit companies began arriving in the 1890's to grow bananas in Honduras. The companies cleared forests and drained swamps for plantations in the Northern Coast region, and they built railroads and ports. They also established towns, hospitals, and schools for the workers.

In the early 1900's, bananas became Honduras's leading source of income. Export taxes paid by the U.S. fruit companies took care of most of the Honduran government's expenses. The government gave the companies special privileges to increase this income, and the firms developed a strong influence over the government. The term *banana republic,* referring to a number of Latin American countries, was first used for Honduras.

Revolutions and reforms. Until 1933, most Honduran presidents did not serve long because of frequent revolutions. General Tiburcio Carías Andino became president in 1933 and held office for 16 years, the longest period. Carías ruled as a dictator. Several revolts failed to overthrow him, and he retired in 1948.

More political violence during the 1950's led to the election of Ramón Villeda Morales, a physician, who became president in 1957. Villeda established a land reform program, and built hospitals, roads, and schools.

In 1963, a military revolt led by Colonel Osvaldo López Arellano overthrew the government. An elected assembly wrote a new constitution that provided for López to become president. In 1971, the voters elected Ramón Ernesto Cruz, a lawyer, to the presidency. But in 1972, the armed forces overthrew the Cruz government and López again became president.

In 1969, a Honduran land reform law forced many families from El Salvador living in Honduras to give up their land. Salvadoran troops entered Honduras in July 1969 but left in August. In 1970, the Organization of American States helped the two nations set up a neutral zone along their border. In 1992, the countries ended their border dispute.

In 1975, the armed forces removed López from office and replaced him with Colonel Juan Alberto Melgar Castro. López's government had been involved in a scandal over a bribe from a U.S. firm to reduce the export tax on bananas. In 1978, three leaders of the armed forces removed Melgar from office and took over. In 1981, elections for a civilian government were held. The voters elected a civilian president and a legislature.

Recent developments. During the 1980's, Honduras became a site of clashes between troops of the Sandinista government of Nicaragua and Nicaraguan rebels trying to overthrow the Sandinistas. The rebels, called *contras,* set up bases in Honduras and raided Nicaragua from the bases. Sandinista troops sometimes entered Honduras to attack the contras. In March 1988, the contras and the Sandinista government signed a cease-fire agreement. In 1990, the Sandinista government of Nicaragua was voted out of office. The contra bases in Honduras were then shut down.

Since 1981, the voters of Honduras have elected a new president and legislature every four years. Ricardo Maduro Joest was elected president in 2001.

In 1998, Hurricane Mitch struck Honduras, producing floods and landslides throughout the country. The storm killed about 7,000 Hondurans and destroyed about 70,000 homes. It caused about $1.7 billion in damage. It ruined half of the country's crops and washed away most of its roads and bridges.

Gary S. Elbow

Related articles in *World Book* include:

Banana
Central America
Copán
Latin America
Maya
Mosquito Coast
San Pedro Sula
Tegucigalpa
Valle, José Cecilio del
Walker, William

George Holton, Photo Researchers

A Maya ball court can still be seen at Copán, the site of an ancient city. The Maya played a sacred game on courts like this.

Outline

I. Government
II. People
A. Ancestry
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III. The land
A. The Mountainous Interior
B. The Northern Coast
C. The Northeastern Plain
D. The Southern Coast
IV. Climate
V. Economy
A. Agriculture
B. Service industries
C. Manufacturing
D. Transportation
E. Communication
VI. History

Questions

How did Honduras get its name?
What is Honduras's leading source of income?
How did U.S. fruit companies influence Honduras?
What ancient civilization thrived in Honduras?
What is the main food of the Hondurans?
What country is Honduras's major trading partner?
Where do Honduras's *cloud forests* grow?
Which region is the banana-producing region of Honduras?
What are Honduras's chief manufactured products?

Honecker, *HOHN uhk uhr,* **Erich,** *AY rihk* (1912-1994), was the leader of East Germany from 1971 until 1989. He came to power when he succeeded Walter Ulbricht as first secretary (later general secretary) of the ruling Communist Party.

In the 1980's, large numbers of East Germans became increasingly dissatisfied with the lack of freedom under Honecker's rule. In 1989, many of them fled to West Germany. In October 1989, Honecker was forced to resign as general secretary. In December, he was expelled from the Communist Party. He had become wealthy through his position as leader of East Germany. In 1990, East and West Germany were reunified into the single nation of Germany. Reunified Germany charged Honecker with manslaughter for ordering border guards to shoot East Germans trying to escape to West Germany during his leadership. His trial began in late 1992. But ill health soon prevented him from attending, and Germany suspended its charges in January 1993. Honecker was exiled to Chile, where he died in May 1994.

Honecker was born in Neunkirchen, Germany. He joined the Communist Party in 1929. From 1935 to 1945, he was held in prison by the Nazis. From 1946 to 1955, Honecker served as chairman of an East German Communist youth group called Free German Youth. He was elected to the East German legislature in 1949. During the mid-1950's, he studied Communist theory and practice in the Soviet Union. In 1958, he became a member of the Political Bureau, the governing body of the East German Communist Party. Honecker served as secretary for military and security affairs from 1958 to 1971. In this post, he was in charge of the construction of the Berlin Wall in 1961. In 1976, he was named to the government office of chairman of the council of state. He was forced to resign that post when he resigned as general secretary of the Communist Party. Melvin Croan

Honegger, *HOH nehg uhr,* **Arthur** (1892-1955), was a Swiss-French composer. In the early 1920's, he was associated with *Les Six,* a group of six French composers who rejected the prevailing taste for romanticism and impressionism in music. Honegger developed a highly personal style that featured energetic rhythms. Writing in a style that is clearly tonal most of the time, he occasionally composed passages with *polytonal* and *atonal* harmonies. Honegger's most popular composition is the short symphonic piece *Pacific 231* (1924), which portrays in rhythm the motion of a locomotive. He wrote many works for the theater, notably *King David* (1921) and *Joan of Arc at the Stake* (1938). He also composed symphonies, concertos, piano and chamber music, and works for chorus and solo voice. Honegger was born in Le Havre, France. Daniel T. Politoske

Honey is a sweet, thick fluid made by bees from flower nectar, a sugar-filled, watery liquid. Worker bees sip nectar from flower blossoms and carry it to their hives, where they share it with other worker bees. Each bee has a pouch in her body, called a *honey stomach,* where the nectar is temporarily stored. In the pouch, *enzymes* produced by the bee mix with the nectar. An enzyme is a molecule that speeds chemical reactions. Most enzymes are proteins. The enzymes in the honey stomach promote *inversion,* a process in which the sugar in the nectar breaks down into two simple sugars, *fructose* and *glucose.*

A. J. Deane, Bruce Coleman Ltd.

Bees store nectar in their hives in tiny, six-sided containers called cells, *shown here.* After it is stored in the cells, the water in the nectar evaporates, and the nectar changes into honey.

After inversion is complete, the bees use their mouthparts to expose the nectar to the hive's warm air. Some water in the nectar evaporates. The bees then deposit the nectar in a *honeycomb,* a mass of six-sided compartments called *cells.* In the cells, water continues to evaporate from the nectar. Nectar becomes honey when it contains, on the average, less than 19 percent water by weight.

Kinds of honey. The color and flavor of honey depend upon the kinds of flowers that supply the nectar. Honey ranges in color from white through dark amber, and it can have a mild or strong flavor. Most honey sold in stores is mild.

The most common honey plants are alfalfa, clover, aster, sunflower, citrus, goldenrod, and various wild flowers. Many regional plants in the United States produce excellent honey. In the East, tasty honeys come from nectars of buckwheat, sumac, and the yellow-poplar, or tuliptree. In the Midwest, honey from basswood nectar is popular. In the South, bees produce tasty honeys from tupelo, mesquite, sourwood, and gallberry nectars. White sage honey is popular in California.

Most honey will eventually *granulate* (develop sugar crystals) because honey is made primarily of sugar and water. Commercial users such as bakers heat honey to delay granulation. Granulated honey may be turned

Leading honey-producing states and provinces

Amount of honey produced in a year

Alberta	38,335,000 pounds (17,388,000 kilograms)
California	37,350,000 pounds (16,942,000 kilograms)
North Dakota	29,440,000 pounds (13,354,000 kilograms)
Florida	22,540,000 pounds (10,224,000 kilograms)
Saskatchewan	21,840,000 pounds (9,906,000 kilograms)

Figures are for 1998.
Sources: U. S. Department of Agriculture; Statistics Canada.

back into liquid by placing a container of honey into warm water. Finely granulated honey is sometimes sold as *creamed honey*.

Food value. Honey is an excellent energy food because it contains simple sugars that the body can use quickly. Honey also contains small amounts of minerals and other materials used by the body.

The honey industry. World production of honey totals about $2\frac{1}{2}$ billion pounds (1.1 billion kilograms) each year. China is, by far, the leading honey-producing country, followed by the United States. Other important honey-producing countries include Argentina, Belarus, India, Mexico, Russia, Turkey, and Ukraine.

Many beekeepers in the United States travel with their bees from the Southern States to the North each year to follow the blooming of honey plants. The beekeepers carry their hives on large trucks that are covered with nets. Most beekeepers sell their honey after it has been removed from the honeycomb by a *honey extractor*. This machine whirls the honeycombs around, forcing the honey out. After the honey has been removed from the honeycomb, it is ready to be packaged and sold.

History. Honey was an important sweet in ancient times. During the Middle Ages, people kept bees in woven straw baskets called *skeps*. In the 1500's and 1600's, European colonists brought honey bees to the Americas. Lawrence J. Connor

See also Bee; Beeswax.

Honey bee. See Bee.

Honey locust is a medium-sized tree with spreading branches and handsome, finely divided leaves. Two species are found in North America. Ten additional species are native to Asia, Africa, and South America. The bark of a honey locust is furrowed. In some kinds, stout spines grow on the trunk and branches. The fruits look like long, somewhat flattened and twisted pea pods. They contain a sweetish pulp used as cattle feed. The wood from the honey locust tree is hard, heavy, and durable. It is used for fuel, posts, railroad ties, and veneer. Honey locust trees are grown in the United States as shade trees and ornamentals. They also are used in windbreaks. Richard C. Schlesinger

Scientific classification. Honey locusts are members of the pea family, Fabaceae or Leguminosae. Honey locusts make up the genus *Gleditsia*. The common honey locust is *G. triacanthos*.

See also Locust (tree); Tree (Familiar broadleaf and needleleaf trees [picture]).

Honeybee. See Bee.

Honeycreeper. See Hawaiian honeycreeper.

Honeyeater is the name of a family of about 170 species of land birds. Most honeyeaters live in Australia and New Guinea, but some are found in Hawaii and on other islands in the Pacific Ocean. Two kinds of honeyeaters, called *sugarbirds*, live in South Africa.

Honeyeaters have a long, tube-shaped tongue with brushlike edges. This tongue is especially suited for eating nectar from flowers. When honeyeaters are looking for nectar, they sometimes carry pollen from one plant to another (see Pollen). The birds also eat berries, fruits, and insects, but they digest nectar faster. Honeyeaters may get intoxicated and cannot fly if the nectar they eat has been *fermented* (turned into alcohol) by rain and sunlight.

© Leonard Lee Rue III, Earth Scenes

The honey locust has spreading branches.

WORLD BOOK illustration by James Teason

The honeyeater gets its name from its habit of eating nectar from the blossoms of trees and shrubs. These birds also eat caterpillars, spiders, and berries and other fruits.

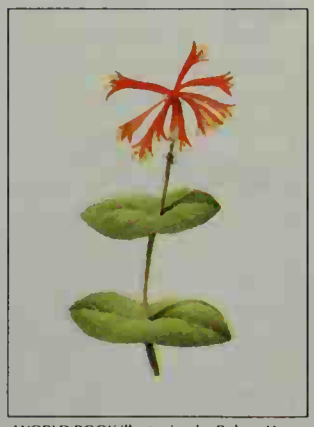
Most honeyeaters are greenish- or grayish-brown with yellow or white marks on their heads. They range from about 3 to 20 inches (7 to 50 centimeters) long. Most honeyeaters live in forests and build cup-shaped nests in trees and bushes. They lay one to four eggs at a time. Some species can sing well, but most honeyeaters make only harsh, unpleasant noises.

Honeyeaters have become almost extinct on the Hawaiian Islands since white people settled there. American and English settlers brought animals that killed these birds. The destruction of forest areas has also reduced the number of honeyeaters. Five species once lived in Hawaii. But in the mid-1980's, only one bird of one species, the Kauai oo, was known to have survived. A Molokai oo, a bird last reported in Hawaii in 1904, was believed to have been seen in 1981. James J. Dinsmore

Scientific classification. Honeyeaters make up the family Meliphagidae.

Honeysuckle is any one of a family of ornamental shrubs and vines. Most honeysuckles are evergreens, or nearly so. They live in temperate regions throughout the world. All have dark green, oval leaves that are usually quite smooth and grow opposite each other in pairs. Sometimes, the bases of the leaves are united around the stem. In other plants, the woody stem seems to grow through the leaves.

Honeysuckles usually produce many trumpet-shaped flowers. The blossoms of some are small, but all are quite beautiful. Many are fragrant. The colors vary from white, yellow, pink, and purple to bright scarlet. When the petals drop off, red, yellow, white, black, or blue berries form. Many birds eat these berries and carry the seeds away, distributing the plants widely.



WORLD BOOK illustratinn by Robert Hynes

Coral honeysuckle

Most honeysuckles are hardy and easy to grow. Gardeners raise the plants either from cuttings or from seeds. Honeysuckles grow compactly and seldom need pruning. Bush honeysuckles are grown as shrubs, and some types grow well in rock gardens. Vine honeysuckles are often trained to twine over walls or fences.

Various insects bring pollen to the honeysuckles. The white-flowered kinds lure sphinx moths at night. The *bush honeysuckle,* with its small yellow blossoms, attracts bees. The *coral,* or *trumpet, honeysuckle* has blossoms that are red outside and orange-yellow inside. Hummingbirds like the sweet nectar of these honeysuckle flowers. Some honeysuckles are also called *woodbine.* Daniel F. Austin

See also Elder; Snowball.

Scientific classification. Honeysuckles belong to the honeysuckle family, Caprifoliaceae. The scientific name for the bush honeysuckle is *Diervilla lonicera.* The coral honeysuckle is *Lonicera sempervirens.* Woodbine is *L. periclymenum.* Two species widely used in landscaping are *L. tatarica* and the fragrant *L. fragrantissima.*

Hong Kong (pop. 6,566,000) is a special administrative region of China. It lies on China's southern coast, near the mouth of the Zhu Jiang (Pearl River). Hong Kong is a major port of Asia. It is also a center of trade, finance, and tourism.

Hong Kong consists of a peninsula attached to the mainland of China, and more than 235 islands. The peninsula has two sections—the New Territories in the north and the Kowloon Peninsula in the south. The main island, Hong Kong Island, lies south of the peninsula.

Hong Kong was part of China from ancient times until the 1800's. Through treaty agreements with China, Britain gained control of Hong Kong Island in 1842 and of the Kowloon Peninsula and tiny Stonecutters Island west of the peninsula in 1860. On July 1, 1898, China leased to Britain for 99 years the New Territories and the rest of the islands. China demanded the return of the entire colony when the New Territories lease expired and took control of Hong Kong on July 1, 1997.

The major cities

The cities of Kowloon and Hong Kong are the region's largest cities and its main centers of business, industry, and tourism. Many small shops, open markets, and high-rise buildings line the narrow streets of these areas.

Kowloon and Hong Kong lie on opposite sides of Victoria Harbour. Kowloon is on the southern part of the mainland, and Hong Kong lies on the northern part of Hong Kong Island. The two cities are connected by ferries, three motor-vehicle tunnels under the harbor, and an underwater subway. Every day, millions of people travel between the cities to work or to shop. The Chinese call the entire area *hong kong* (fragrant harbor).

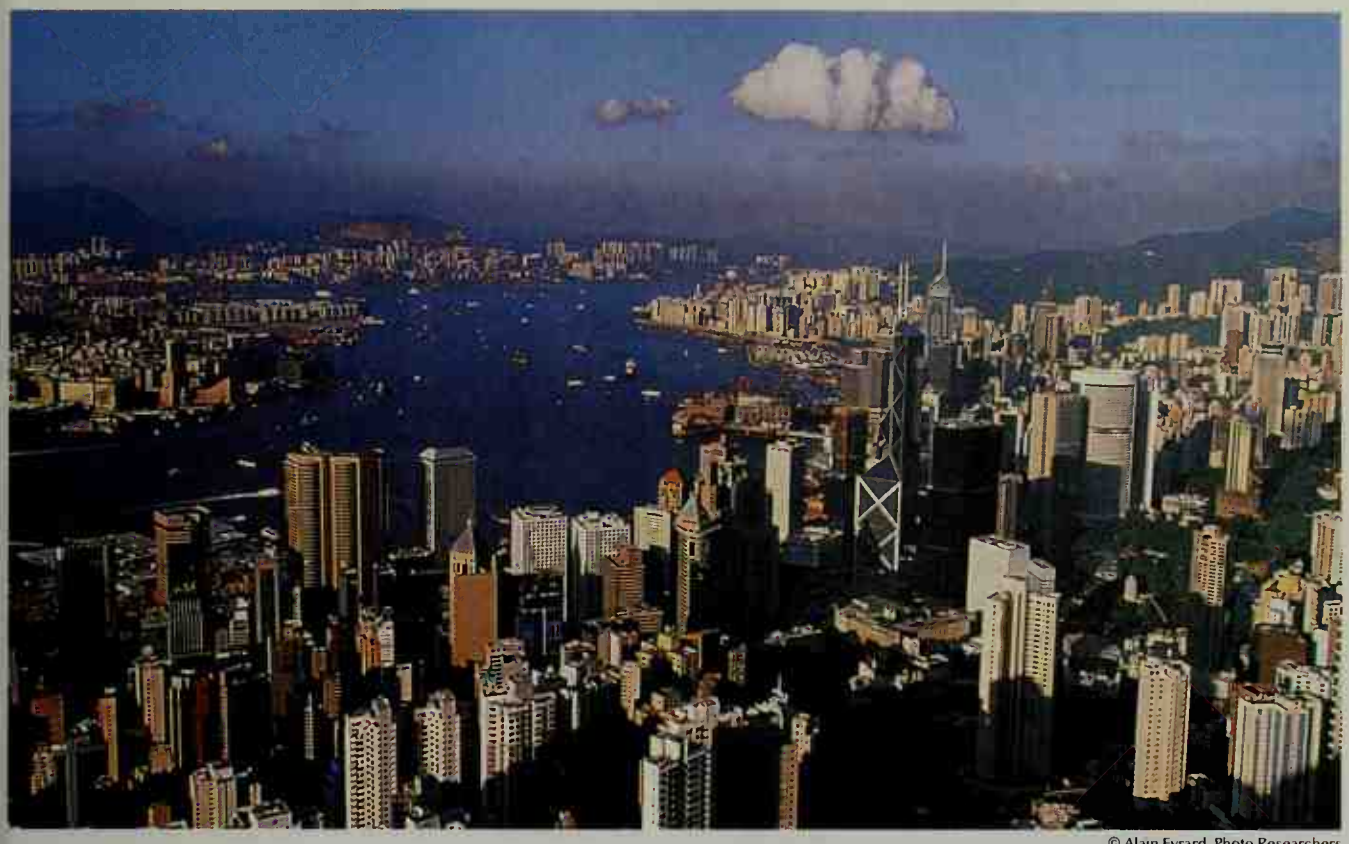
Kowloon is the region's largest and most crowded city. About 2 $\frac{1}{2}$ million people live in this urban area.

The area in south Kowloon at the tip of the peninsula is called Tsim Sha Tsui. Passenger ships dock there at Ocean Terminal, one of the largest piers in Asia. Tsim Sha Tsui has many shops, hotels, and restaurants, and it is a major shopping area for tourists. Tourists also flock to stores along Nathan Road in the center of Kowloon to buy cameras, jewelry, custom-made clothing, and other products. Many merchants sell their goods in the streets or at open-air marketplaces. The marketplaces offer such items as fresh vegetables, fish and poultry, and household goods. Northern Kowloon has many public housing developments and factories.

A railroad runs through the New Territories and connects Kowloon with Guangzhou, China. Ferries, buses, and airlines also provide service between Kowloon and Guangzhou.

Hong Kong has a population of about 1 $\frac{1}{2}$ million. The city's Central District, often called simply Central, is the region's seat of government and financial center. Government buildings and banks and other financial establishments are in Central District. Residents own some of the banks. Others are branches of banks of Britain, China, Japan, the United States, and other countries. The towering Bank of China building, designed by Chinese-American architect I. M. Pei, is one of the tallest buildings in the world. It stands at the eastern edge of Central District. High-rise commercial buildings and fashionable shops and hotels stand along the waterfront.

Many people live in crowded apartments in the Wan



© Alain Evrard, Photo Researchers

Hong Kong's largest cities lie across Victoria Harbour from one another. The city of Hong Kong, *foreground,* is the center of government. Kowloon, *background,* has the most people.

Chai area, east of Central District. Many government buildings stand on filled-in land along the Wan Chai coast. A business center has sprung up around them. To the east of this center is the Japanese shopping district of Causeway Bay.

A beautiful mountain called Tai Ping Shan (also called Victoria Peak) rises southwest of Central District. Luxury apartment buildings and attractive houses line the steep sides of the mountain. A railway called the Peak Tram transports passengers between Central District and the top of the mountain.

People

Hong Kong covers a total area of 1,126 square miles (2,916 square kilometers). Only about 415 square miles (1,075 square kilometers) is land. On average, Hong Kong has about 15,800 people per square mile (6,100 per square kilometer) of land. But much of Hong Kong's land is mountainous and uninhabitable. As a result, the population density varies widely. Hong Kong's cities are among the world's most crowded places.

Ancestry. About 98 percent of the people of Hong Kong are Chinese. Most are immigrants from southern China or descendants of immigrants from that region. The relatively few non-Chinese residents of Hong Kong include people from Australia, Britain, India, Japan, the United States, and Vietnam.

Languages. Hong Kong has two official languages, Chinese and English. Most of Hong Kong's Chinese people do not speak or understand English well, if at all. The majority of them speak Cantonese, a dialect of South China. Many people are learning *putonghua,* the standard form of spoken Chinese used throughout China.

Way of life

Urban life. About 96 percent of Hong Kong's people live in urban areas. Most urban dwellers live in the cities of Kowloon and Hong Kong.

Other urban settlements include a number of *new towns* in the New Territories. The government established these settlements to attract population from overcrowded urban areas. The new towns include manufacturing facilities as well as housing. The main new towns are Tsuen Wan, Tuen Mun, and Sha Tin. Development of a new town at Tung Chung on northern Lantau Island in western Hong Kong began in the 1990's in connection with the construction of a new airport at Chek Lap Kok.

Housing in Hong Kong's urban areas varies sharply. Rents and land prices are high. Most wealthy people live in luxury apartment buildings, and some live in beautiful houses with gardens. Large numbers of middle- and low-income people occupy crowded high-rise apartment buildings, which stand close together. In many cases, several poor families share one or two small rooms.

Urban housing also includes huge apartment complexes that were built by the government. These dwellings provide low-rent accommodations for millions of people. The government charges rents according to the tenants' ability to pay. The government also encourages home ownership through the provision of subsidized housing or financial assistance.

Rural life. People in rural areas of Hong Kong live in small farming villages and raise crops and livestock. Some farmers still plant and harvest crops by hand or with hand tools. But new farming methods and machinery promoted by the government have enabled many

of Hong Kong's farmers to increase their production.

The majority of Hong Kong's rural people live in one- or two-story houses made of brick or stone. Most of the homes have tile or tin roofs. Some rural villages were settled more than 1,000 years ago.

Food and clothing. The people of Hong Kong eat large amounts of fresh vegetables, fish, and rice, and some poultry and pork. Many people wear the same type of clothing worn in Western countries. Others wear Chinese-style clothing, such as dark-colored pants and shirts, and long robes.

Religion. The major religions in Hong Kong are Buddhism and Taoism. About 10 percent of the people are Christians. Small groups of Hindus, Jews, and Muslims also live there.

Education. All children are required by law to go to school for nine years—six years of elementary school and three of high school. Classes in elementary schools are taught in Chinese. Some high schools use Chinese, some use English, and others use both languages.

Hong Kong has seven universities. The oldest is the University of Hong Kong, which was founded in 1911. Other universities include the Chinese University of Hong Kong, the City University of Hong Kong, the Hong Kong Baptist University, the Hong Kong Polytechnic University, the Hong Kong University of Science and Technology, and Lingnan College.

Land and climate

The land. Rugged mountains and rolling hills cover much of Hong Kong. The rocky, indented coastlines of Hong Kong's islands and mainland provide many small harbors for fishing villages. Some mountains in the New Territories rise more than 3,000 feet (900 meters) above sea level. Tai Ping Shan on Hong Kong Island is 1,818 feet (554 meters) high.

Barren mountains separate the business districts of the Kowloon Peninsula from farmland in the New Territories. Only about 8 percent of the land in Hong Kong is suitable for farming. Throughout the New Territories, poultry farms and vegetable and flower fields lie crowded between areas of poor vegetation and rocky hillsides. The Sham Chun (or Shenzhen) river forms part of the border between Hong Kong and Guangdong Province.

Much of Hong Kong's harbor coastline has been filled in with earth to create new land. An airport at Kai Tak was built on filled-in land in Kowloon Bay. To land at Kai Tak, however, airplanes had to come in for a landing over the densely populated Kowloon area. In 1998, Hong Kong International Airport replaced Kai Tak. The new airport lies on the island of Chek Lap Kok, which also was expanded with landfill to create space. The new town at Tung Chung on nearby Lantau Island provides a supporting community for the airport.

Climate. Hong Kong has hot, humid summers. The winters are cool and less humid. During the summer, temperatures reach 95 °F (35 °C) or higher. Winter temperatures seldom fall below 40 °F (4 °C).

Hong Kong receives about 87 inches (220 centimeters) of rainfall yearly. Most of the rain falls in summer and early fall and causes floods and mud slides. Insufficient rainfall during the winter and other factors cause water shortages. Hong Kong buys millions of gallons of water from a neighboring region of China every year.

WORLD BOOK maps

WORLD BOOK photo by David R. Frazier

Open-air marketplaces in Hong Kong offer fresh fruits and vegetables and a wide variety of other goods for sale. The markets are popular with tourists as well as local residents.

Economy

Hong Kong is a center of international trade, finance, and tourism. It is a *free port*—that is, it collects no import duties on goods brought in from elsewhere. As a result, many products can be bought and sold more cheaply in Hong Kong than in most other parts of the world. Hong Kong has efficient telecommunications and a highly educated labor force. Business firms of many countries maintain offices in Hong Kong from which they carry on business with China.

Service industries. Most workers are employed in service industries, especially wholesale and retail trade and community, social, and personal services. Other important service industries include transportation and finance, insurance, and real estate. Hong Kong is one of the world's most important gold trading centers. Its many banks finance housing, manufacturing, and trade in Hong Kong as well as in other parts of the world. Millions of tourists visit Hong Kong annually. The money they spend greatly aids the economy.

Manufacturing. Hong Kong's many factories make a variety of products. Almost all manufactured products are sold to the rest of China or exported. Textiles and clothing account for about half the exports. Hong Kong also exports large quantities of electrical appliances, electronic equipment, plastic products, and watches and clocks. It sells its products chiefly to the rest of China and to Germany, Japan, Singapore, the United Kingdom, and the United States. It purchases large quantities of food, machinery, and other raw materials mostly from China, Japan, Taiwan, and the United States.

Agriculture and fishing. Agriculture is a minor economic activity in Hong Kong. Farm products include flowers, hogs, poultry, and vegetables. But Hong Kong also imports large amounts of food to meet its needs.

Fishing fleets catch bigeyes, false snappers, lizardfish, squid, and other seafood. Because there is a high demand for fish among the people of Hong Kong, fisheries also raise fish. Fisheries raise saltwater fish on the coast of the eastern New Territories and freshwater fish in ponds in the northwestern part of the New Territories.

Government

The foundation of Hong Kong's government is the Basic Law, which became effective on July 1, 1997, when Hong Kong was transferred from British to Chinese rule. The Basic Law upholds the principle of "one country, two systems," which gives the Hong Kong special administrative region a high degree of *autonomy* (self-rule). China's National People's Congress has the authority to approve Hong Kong's laws and appointments of government officials. According to the Basic Law, Hong Kong may elect deputies to the Congress.

The chief executive heads the government of Hong Kong and serves a five-year term. A committee of about 800 members elects the chief executive. The election committee consists of citizens from various social and economic levels and members of several government bodies.

The Executive Council helps carry out government operations. The chief executive chooses the council members.

The Legislative Council is Hong Kong's lawmaking body. The council has 60 members, who serve four-year terms. The people of Hong Kong directly elect 24 members of the council. Members of professional and other interest groups, called *functional constituencies,* elect 30 members. The other 6 members are elected by an 800-member election committee.

History

Early days. People have lived in what is now Hong Kong since ancient times. The area came under Chinese control about 220 B.C. Until the A.D. 1800's, it consisted of small fishing and farming villages. Pirates used Hong Kong as a land base.

British control. During the 1800's, the Chinese government tried to stop British merchants from smuggling opium into China. In 1839, this issue led to the Opium War between China and the United Kigdom. The United Kingdom won the war and took control of the island of Hong Kong as part of the Treaty of Nanjing in 1842. In 1860, the United Kingdom gained control of the Kowloon Peninsula and tiny Stonecutters Island west of the peninsula as part of a settlement of further trade disputes with China. In 1898, China leased to the United Kingdom for 99 years the New Territories and the many islands that made up Hong Kong.

During the late 1800's and early 1900's, Hong Kong served as a port for British trade with China. In 1911 and 1912, a wave of immigration from China greatly increased Hong Kong's population. During that period, Chinese revolutionaries overthrew China's Manchu dy-

nasty and established the Republic of China. Many Chinese people fled to Hong Kong. In 1937, Japan invaded China and, once again, large numbers of Chinese fled to Hong Kong. From 1941 to 1945, during World War II, the population of Hong Kong decreased. Japanese troops occupied Hong Kong during that period, and many Chinese returned to China.

In 1949, Communists took control of China. Many Chinese people moved to Hong Kong. The Chinese Communist government never formally recognized the United Kingdom's control of Hong Kong. But it did not actively oppose British rule, probably because Hong Kong has great value for the Chinese economy. In the 1950's, Hong Kong began to develop into a center of international trade and finance, and it also began to develop many industries.

In 1962, a threat of widespread starvation in China set off another wave of Chinese immigration to Hong Kong. In the late 1960's, some of Hong Kong's Chinese residents held violent demonstrations against British control. But the Chinese government did not try to take control of Hong Kong, and the riots ended. In the late 1970's and the 1980's, following the Vietnam War (1957-1975), thousands of Vietnamese fled to Hong Kong.

The return to Chinese rule. In the early 1980's, China and the United Kingdom began negotiations on an agreement to transfer Hong Kong back to China when the United Kingdom's lease of the New Territories expired in 1997. The agreement, signed in 1984, stated that Hong Kong would become a special administrative region (SAR) of China on July 1, 1997. China declared the relationship would be that of "one country, two systems." Under the terms of the agreement, Hong Kong would be allowed to maintain its free-enterprise economy within the government-controlled economic system of China for at least 50 years after 1997.

After the signing of the agreement, economic cooperation between Hong Kong and China increased dramatically. China began to invest more and more money in Hong Kong to help strengthen Hong Kong's economy as well as the Chinese economy. Hong Kong industrialists began moving manufacturing activities to China's Pearl River Delta to take advantage of the inexpensive labor available there. Much employment in Hong Kong shifted from low-cost manufacturing to service industries.

In 1985, committees were established to prepare the Basic Law, the framework for Hong Kong's administration. The Basic Law was approved by the Chinese government in 1990 and went into effect on July 1, 1997. According to the provisions of the Basic Law, the Hong Kong SAR retains its own executive, legislative, and judicial power. It may issue its own currency and passports, maintain its own customs force and police, and remain a free port. China is responsible for Hong Kong's defense and foreign policy. Chor-Pang Lo

Honiara, *HOH nee AHR uh* (pop. 30,499), is the capital and largest community of the Solomon Islands, an island country in the southwestern Pacific Ocean. Honiara, a port town, is on the north coast of Guadalcanal Island (see **Solomon Islands** [map]). The town lies on two sides of a harbor that serves both small and seagoing ships. Since the 1970's, several multistory business and government buildings have been built in the community's rapidly growing commercial center.

Honiara stands near a former coconut plantation that Japan, and later the United States, turned into an airfield and military base during World War II (1939-1945). The town became the capital of the Solomon Islands soon after the war ended. Geoffrey M. White

Honolulu, *HAHN uh LOO loo* or *HOH noh LOO loo,* is the capital, largest city, and chief port of Hawaii. The city's official name is the City and County of Honolulu. Technically, Honolulu covers the entire island of Oahu. But only the large urban area on Oahu's southeastern coast is commonly called Honolulu. Other communities on Oahu are known by their own names.

Honolulu is often called the *Crossroads of the Pacific.* It is about 2,400 miles (3,860 kilometers) from San Francisco and 3,800 miles (6,120 kilometers) from Tokyo.

In 1794, Captain William Brown of England sailed into what is now Honolulu Harbor. The harbor provided shelter, and other ships began to stop there. Honolulu soon became an important trading center. *Honolulu* is a Hawaiian word meaning *sheltered bay.*

During the early 1900's, the United States built several military bases on Oahu. On Dec. 7, 1941, Japanese planes bombed Pearl Harbor, a U.S. naval base on the island. The United States entered World War II the next day. In the 1960's, jet air travel and lower plane fares helped Honolulu become a popular tourist spot. Tourism continues to be a major industry in Honolulu.

The city. The City and County of Honolulu consists of Oahu and several offshore islands and covers 621 square miles (1,608 square kilometers). The City and County of Honolulu and the Honolulu metropolitan area have the same boundaries.

The main urban area of Honolulu covers 86 square miles (223 square kilometers) on Oahu's southeastern coast. It has more than 370,000 people. This area includes downtown Honolulu and extends about 20 miles (32 kilometers) along the shore from Pearl Harbor on the west to Koko Head, an extinct volcano, on the east.

Diamond Head, Honolulu's most famous extinct volcano, is west of Koko Head. The Koolau Mountains rise north of the main urban area of Honolulu, and the Waianae Mountains are west of this area.

Downtown Honolulu, which lies next to Honolulu Harbor, has many office and apartment buildings. Government buildings in the downtown area include City Hall and the Hawaii State Capitol. Iolani Palace, the former capitol and once the royal palace of Hawaiian monarchs, stands across a walkway from the new capitol. The governor of Hawaii lives in Washington Place, a home of Queen Liliuokalani, Hawaii's last monarch.

Factories occupy districts west of downtown Honolulu. The Ala Moana Center, a large shopping area, and Waikiki, a famous coastal resort section, lie east of the downtown district.

Facts in brief

Population: *City and County of Honolulu and metropolitan area*—876,156. *City of Honolulu*—371,657.
Area: *City and County of Honolulu and metropolitan area*—621 mi² (1,608 km²). *City of Honolulu*—86 mi² (223 km²).
Government: Mayor-council. *Terms*—4 years for the mayor and the 9 council members.
Founded: 1794. Incorporated as a city and county in 1907.

Residential communities have grown up throughout Honolulu. The largest communities include Aiea, Kailua, Kaneohe, Pearl City, and Waipahu.

The people. More than half of Honolulu's people are of Asian descent, and about a fourth have Japanese ancestry. About a fifth of the people are white. About 16 percent of the people are Hawaiian or part Hawaiian. Other groups include those of African, Chinese, Filipino, Korean, Puerto Rican, or Samoan descent. Many of the people have mixed ancestry. American military personnel and their families make up over 10 percent of Honolulu's population.

Economy. Tourism is Honolulu's largest source of income. Millions of tourists visit the city annually. Most of them stay in the Waikiki Beach area. Visitors enjoy the beautiful scenery, recreation areas, and mild climate. The city's temperature varies little, averaging 72 °F (22 °C) in February, the coldest month, and 78 °F (26 °C) in August and September, the warmest months. For the monthly weather in Honolulu, see **Hawaii** (Climate).

Honolulu's economy also depends on military activities. The city is the center of United States military operations in the Pacific region. The Air Force, Army, Marine Corps, and Navy have bases on Oahu. The second largest source of income in Honolulu is the money spent by the U.S. government in salaries for military personnel and civilian workers.

Honolulu is the headquarters for several small high-technology firms. The city also has hundreds of manufacturing companies. Honolulu's products include cement, clothing, furniture, glass products, lumber, oil products, and plastics. Workers also process pineapples for shipping to other areas.

The Honolulu International Airport handles millions of passengers each year. A steamship terminal operates at Honolulu Harbor.

Two English-language newspapers, *The Honolulu Advertiser* and the *Honolulu Star-Bulletin,* have the largest daily readerships in Honolulu. The city also has daily newspapers printed in Chinese, Japanese, and Korean.

Education. Honolulu's public schools form part of the state school system controlled by the Hawaii State Board of Education. Also, thousands of students attend private schools.

The University of Hawaii at Manoa is in Honolulu. Its Hamilton Library is the largest library in Hawaii. The East-West Center, also on the Manoa campus, is a meeting place for people of Eastern and Western nations to get together and exchange ideas. Chaminade University of Honolulu and the main campus of Hawaii Pacific University are also in Honolulu.

Cultural life. The Honolulu Symphony Orchestra performs in concerts and operas. The Honolulu Community Theater and the Kennedy Theater at the East-West Center present plays and other stage productions. Leading ballet and opera companies appear at the Neal S. Blaisdell Center, which includes an arena, an auditorium, and an exhibition hall.

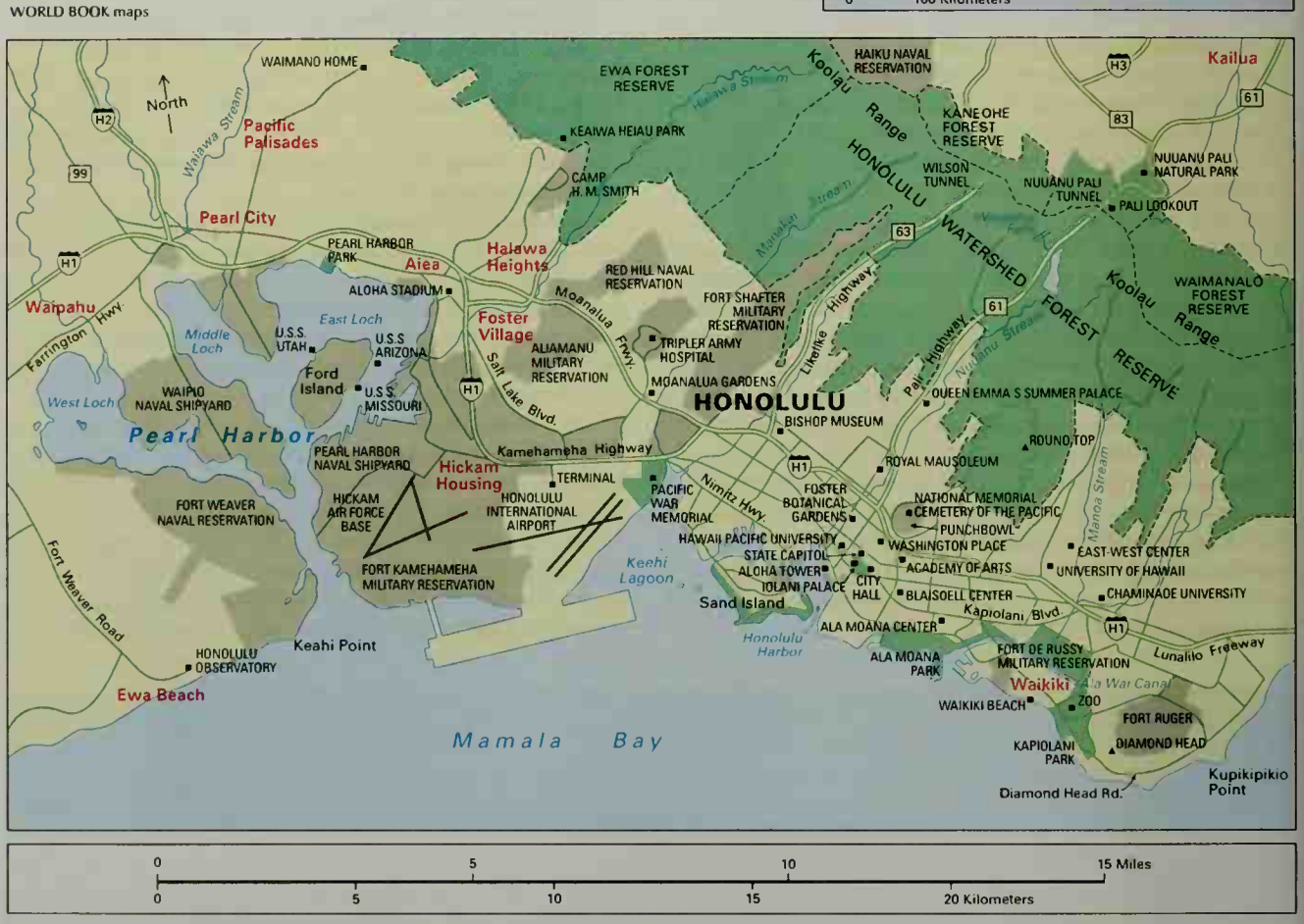
The Bernice P. Bishop Museum, which opened in 1889, is the oldest museum in Hawaii. It has exhibits of natural history and Pacific Island culture. The Honolulu Academy of Arts displays Western and Asian art. The Polynesian Cultural Center includes seven villages representing the people of Fiji, Hawaii, the Marquesas Islands, New Zealand, the Samoa Islands, Tahiti, and Tonga. Many tourists visit Queen Emma's Summer Palace,

Jack Zehrt, FPG

Waikiki Beach and Diamond Head Crater are landmarks of Honolulu. Waikiki, *foreground,* is a popular resort area, and Diamond Head, *background,* is an extinct volcano.

Honolulu

Honolulu is Hawaii's capital, largest city, and major port. It occupies the entire island of Oahu, which is shown on the map at the right. The map below shows the chief points of interest located in central Honolulu.



which was a home of the wife of King Kamehameha IV.

Honolulu has many beautiful parks. Ala Moana and Kapiolani parks offer a variety of recreational facilities. Trained dolphins and other marine animals perform at Sea Life Park. The Foster Botanical Gardens feature 9 acres (4 hectares) of rare flowers and trees.

Government. The City and County of Honolulu has a mayor-council form of government. The voters elect the mayor and the nine members of the council to four-year terms. Property taxes provide about half of the revenue.

History. Honolulu was a small Polynesian village when an English seaman, Captain William Brown, sailed into its harbor in 1794. Other ships started to use the harbor, and Honolulu became an important port.

During the 1800's, Honolulu flourished first as a center for the sandalwood trade and later as the major Pacific whaling base. In 1820, Protestant missionaries from New England came to Honolulu. They built schools and churches and converted many Hawaiians to Christianity.

During the late 1800's, farmers began to raise large crops of pineapples and sugar cane. The processing of these products became the city's most important manufacturing activity. Thousands of laborers from China, Japan, and other countries came to work in the pineapple and sugar fields and the food-processing factories. By 1896, Honolulu had about 30,000 people.

King Kamehameha I, the first ruler of the Kingdom of Hawaii, lived in Honolulu from 1803 to 1811. The city became the permanent capital of Hawaii in 1845, and it remained the capital when Hawaii became a territory of the United States in 1900. The City and County of Honolulu, established in 1907, remained the capital when Hawaii became a state in 1959.

The United States built a naval base at Pearl Harbor in the early 1900's and established several Army camps on Oahu. The increased military activity helped raise Honolulu's population to about 95,000 in 1920 and 137,000 in 1930. The Japanese attack on Pearl Harbor on Dec. 7,

Camera Hawaii

King Kamehameha I founded the Kingdom of Hawaii in the late 1700's. A bronze statue of the great ruler stands in front of the Judiciary Building in Honolulu's civic center.

1941, forced the United States into World War II. Honolulu became a chief base for the Allied campaign against the Japanese.

The late 1940's and 1950's brought important social and economic changes to Honolulu. People from China, Japan, and other Asian countries had long been kept out of politics and big business in the city. But after World War II ended in 1945, many Americans of Asian descent became leaders in Honolulu's government and industry.

During the 1960's, the tourism industry boomed in Honolulu and high-rise apartment buildings and hotels went up in the city's main urban area. The start of jet air travel reduced the flying time between cities on the mainland of the United States and Honolulu. Airlines lowered their fares and scheduled more and more flights between many cities and Honolulu.

During the 1970's and the 1980's, Honolulu continued to be a popular place for tourists, and Honolulu's economy grew rapidly. But the rapid growth created several problems. For example, it caused a housing shortage, accompanied by high building costs and limited space. To help ease the shortage, the government gave financial aid to many home builders. Many residents feared that the hotel construction boom threatened Honolulu's scenic beauty. To help solve this problem, Honolulu's government limited hotel construction in certain areas.

In the early 1990's, many Asian nations began to suffer severe economic problems. Honolulu's economy was affected because the number of Asian tourists declined greatly. Also, the Waikiki area began to face competition from vacation areas on other Hawaiian islands and on the mainland of the United States. Many businesses were forced to close or reduce staff. Many residents moved to the mainland of the United States to find jobs.

In 1996, the city government relaxed its earlier restrictions on hotel construction so that Honolulu would be in a position to attract more tourists. In 1999, to encourage development, the city council approved a bill offering property tax exemptions for new nonresidential construction, repairs, and renovations. James P. Kelly

See also Hawaii; Kamehameha I.

Honor. See Medals, decorations, and orders.

Honorius I, *hoh NAWR ee uhs* (? -638), was elected pope in 625. He patterned himself after Pope Saint Gregory I, who died in 604. Like Gregory, he turned his mansion in Rome into a monastery. Honorius rebuilt an aqueduct, remodeled Roman churches, encouraged missionary work in Britain, and negotiated peace with the Lombard tribe (see **Lombards**).

Although Honorius was a superb administrator, he was indifferent to the importance and subtlety of theological arguments. Honorius tried to settle a controversy over the nature of Jesus Christ. He suggested a solution that was rejected almost everywhere in the West and in many places in the East. In 681—43 years after his death—the third Council of Constantinople condemned Honorius's view and branded him a heretic. Honorius was born into a wealthy aristocratic family in the Campania region of southern Italy. Thomas F. X. Noble

Honorius III, *hoh NAWR ee uhs* (? -1227), was elected pope in 1216. After his election, he carried out the plans of Innocent III, the previous pope, for the Fifth Crusade to the Holy Land. He encouraged the Holy Roman Emperor Frederick II to participate in the expedition, but because of weak leadership and Frederick's absence, the crusade failed (see **Crusades**). Honorius was unable to convince Frederick to lead another crusade. In 1218, Honorius began a crusade against the Muslim Moors in Spain. He also continued the crusade started by Innocent III against the Albigenses, a group of heretics in southern France.

Honorius approved the Dominican religious order in 1216 and the *rule* (program of life) for the Franciscan order in 1223, and he encouraged the missionary activities of both orders. In 1226, Honorius ordered the first official compilation of *canon* (church) law. Honorius was born in Rome. His given name was Cencio.

Kenneth Pennington

Hooch, Pieter de. See De Hooch, Pieter.

Hood, John Bell (1831-1879), was a Confederate general who gained fame as a brigade and division commander in General Robert E. Lee's army. He fought gallantly at Gaines' Mill, the second Battle of Bull Run (also called Manassas), Antietam (Sharpsburg), Gettysburg, and Chickamauga.

Hood commanded a corps in the Army of Tennessee and took command of that army with the rank of general in 1864. He fought General William T. Sherman at Atlanta but had to abandon the city. Hood began a campaign in Tennessee but was beaten at Nashville.

Hood was born in Kentucky. He graduated from the U.S. Military Academy. After the war, he lived in Texas and Louisiana. Frank E. Vandiver

See also Civil War (The Atlanta campaign; North to Nashville).

Hood, Mount. See Mount Hood.

Hood, Robin. See Robin Hood.

Hoof is a hard growth on the feet of mammals called *ungulates.* Ungulates include pigs, zebras, horses, and the horned mammals. A hoof is made of horn, a substance developed from the *epidermis* (outer layer of skin). The hoof differs from a nail or claw because it is blunt and it encases the toe or foot. The ungulates are divided into two groups, those with even and odd numbers of toes.

The horse's hoof developed on a single toe. It almost completely circles the bottom of the foot. Asses and zebras also have single toes. The even-toed animals never have more than four toes. Usually, the two middle toes form a *cleft* (divided) hoof. This group includes deer, antelope, sheep, goats, cattle, pigs, and the hippopotamus. Hoofs give the animal a firm footing and protect its feet. Some animals can use their hoofs to defend themselves.

Jerry F. Downhower

See also Horn; Ungulate.

Hoof-and-mouth disease. See Foot-and-mouth disease.

Hooghly River, *HOOG lee,* in Bengal, India, is one of the channels through which the Ganges River flows into the Bay of Bengal. However, the main flow of water from the Ganges has shifted to more easterly channels. The Hooghly flows south for about 150 miles (241 kilometers). Large ships can sail up the Hooghly River as far as Kolkata, 86 miles (138 kilometers) from the sea.

H. J. McPherson

Hook. See Fishing (Hooks).

Hookah. See Pipe (tobacco).

Hooke, Robert (1635-1703), an English experimental scientist, stated the currently accepted theory of elasticity in *Hooke's law.* This law states that the amount an elastic body bends or stretches out of shape (strain) is in direct proportion to the force (stress) acting on it. The law applies as long as the body is still elastic. Increased stress beyond this elastic limit will change the shape of the body permanently. Hooke also built the first Gregorian telescope, an early reflecting telescope. Using an early microscope, he discovered plant cells. In addition, he stated the law of inverse squares (see Light [Measuring light]). Hooke's recognition of the similarity between the motion of a vibrating spring and that of a swinging pendulum led him to develop a balance spring for regulating watches.

Hooke had varied interests and often left experiments unfinished. He recognized aspects of the principle of the law of gravitation before Sir Isaac Newton. But Hooke lacked the mathematical skills and the diligence to demonstrate the theory. He was born on July 18, 1635, in Freshwater, Isle of Wight. Margaret J. Osler

See also Biology (picture: A detailed drawing of a fly); Cell (Cell research).

Hooker, Joseph (1814-1879), was a Union general during the Civil War (1861-1865). At the beginning of the war, he became a brigadier general of volunteers. Later, he rose to the rank of major general and commanded a corps. In the eastern theater he fought in the Battles of the Seven Days, the Second Battle of Bull Run (Manassas), and the battles of Antietam (Sharpsburg) and Fredericksburg. The newspapers called him "Fighting Joe." President Abraham Lincoln appointed him commander of the Army of the Potomac in 1863, but he was defeated at Chancellorsville. Relieved of command at his own request and transferred to the West, Hooker commanded a corps in the Chattanooga and Atlanta campaigns.

Brown Bros.

General Joseph Hooker

Hooker was born in Hadley, Massachusetts, and graduated from the U.S. Military Academy in 1837. He also served in the Mexican War (1846-1848).

John F. Marszalek

See also Civil War (Battle of Chancellorsville).

Hooker, Thomas (1586-1647), was a Congregational preacher and a founder of Connecticut. Hooker exerted strong influence in the drafting of the *Fundamental Orders,* a document under which Connecticut was long governed.

Born in Leicestershire, England, Hooker was educated at Cambridge University and became famous as a preacher. Because of his Puritan beliefs, he fled to the Netherlands in 1630. He went to Newtowne (now Cambridge), Massachusetts, in 1633, and settled as pastor. But his liberal beliefs clashed with Massachusetts conservatism. He thought each church should be independent, and that the people had a right to choose their magistrates and decide what powers they should have. So Hooker moved with his church members to Connecticut in 1636. John W. Ifkovic

See also Connecticut (English settlement).

Hooks, Benjamin Lawson (1925-), served as executive director of the National Association for the Advancement of Colored People (NAACP) from 1977 to 1993. He succeeded Roy Wilkins, who had served as executive director of the NAACP since 1955.

Brown Bros.

Benjamin L. Hooks

Hooks, a lawyer, banker, and minister, resigned as a member of the Federal Communications Commission (FCC) to head the NAACP. In 1972, President Richard M. Nixon had appointed him to the commission. Hooks was the first black member of the Federal Communications Commission, and he worked for equal opportunities for minorities in the communications industry.

Hooks was born on Jan. 31, 1925, in Memphis. He graduated from LeMoyne-Owen College and received a law degree in 1948 from DePaul University. Hooks was appointed assistant public defender in Memphis in 1961. In 1965, he became the first black judge of the Shelby County Criminal Court in Tennessee. Hooks became a minister in 1955 and has served as pastor of churches in Memphis and Detroit. Alton Hornsby, Jr.

Hookworm is a small roundworm that enters the bodies of human beings and some animals through the skin.

Hookworms live as *parasites* in the intestines, sucking up blood and tissue fluids.

Hookworms can cause *anemia* (a shortage of red blood cells). They harm children more than adults. An infected child becomes weak and pale. The child's abdomen and legs may swell, and the child may become dull and listless. Certain hookworms attack animals, including cats and dogs. These hookworms can cause an itchy, red patch on human skin called *creeping eruption*.

Hookworm eggs pass out of the *host* (body in which the worm lives) with the body waste and hatch in moist, warm soil. The *larvae* (young worms) come to the surface of the soil. They burrow into the bare skin of animals that touch them. A person walking barefoot may pick up the worm in this way. A person may also become infected by swallowing impure food or water.

Once in the body, a hookworm enters the bloodstream and is carried to the lungs. The hookworm burrows into air channels there, passes into the throat, and is swallowed into the intestine. When hookworms reach the intestine, they become adults. Serious infections occur when there are more than 100 adult hookworms in the intestine.

Hookworm eggs and larvae can live outside of the host's body only in warm, moist places. For this reason, hookworm disease is commonly found in tropical and subtropical countries.

Improving conditions of sanitation has reduced the amount of infection by hookworms. Medical treatment with drugs is also used today. Recovery is speeded by eating foods high in protein, vitamins, and iron.

Scientific classification. Hookworms belong to the family Ancylostomidae and the roundworm phylum, Nematoda. The scientific names for the two kinds of hookworms that attack people are *Necator americanus* and *Ancylostoma duodenale*.

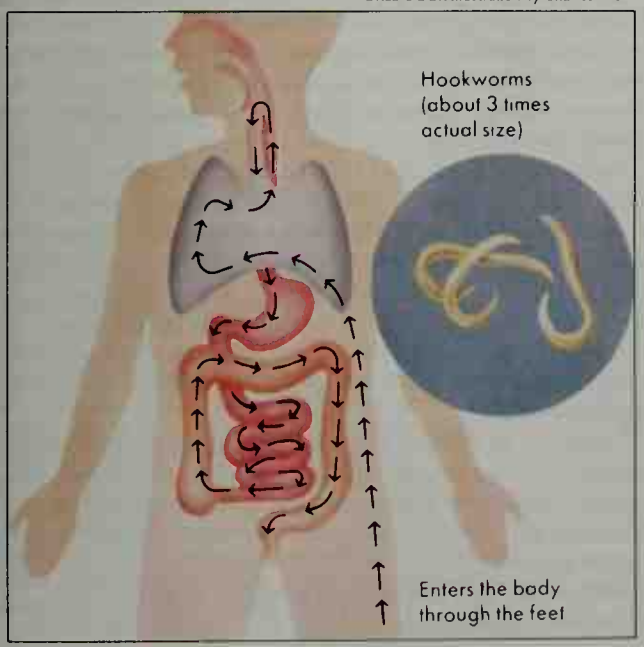
David F. Oetinger

See also **Roundworm**.

The path of a hookworm

A hookworm usually enters the body through the skin. In the body, it enters the bloodstream and is carried into the lungs. It then passes into the throat and is swallowed into the intestines.

WORLD BOOK illustration by Charles Wellek



Hooper, William (1742-1790), was a North Carolina signer of the Declaration of Independence. He served in the Continental Congress from 1774 to 1777 and in all five North Carolina provincial congresses. He favored a mild policy toward the Americans who sided with the British during the Revolutionary War in America (1775-1783), though the British destroyed his property. He strongly supported *ratifying* (passing) the Constitution of the United States. Hooper was born in Boston and graduated from Harvard College. He studied law under James Otis, a leader in the independence movement, who probably influenced his opinions. Robert A. Becker

Hoopoe, *HOO poo,* is a rose-buff colored bird with a showy crest of feathers on its head and black and white bars on its wings and tail. The hoopoe is slightly larger than an American robin. It lives in the warmer regions of Europe, Asia, and Africa.

WORLD BOOK illustration by John Rignall, Linden Artists Ltd.

Hoopoe

Hoopoes nest in holes in trees, walls, and rocks. The female lays four to six eggs. The male feeds the female while she *incubates* (sits on and warms) the eggs. Hoopoes eat insects, worms, and other small animals and spend much time on the ground searching for food. When threatened by other animals, such as hawks, hoopoes flatten themselves on the ground with their wings and tail spread and bill pointed upward.

Scientific classification. The hoopoe makes up the family Upupidae. Its scientific name is *Upupa epops.* David M. Niles

Hoosac Mountains. See Green Mountains.

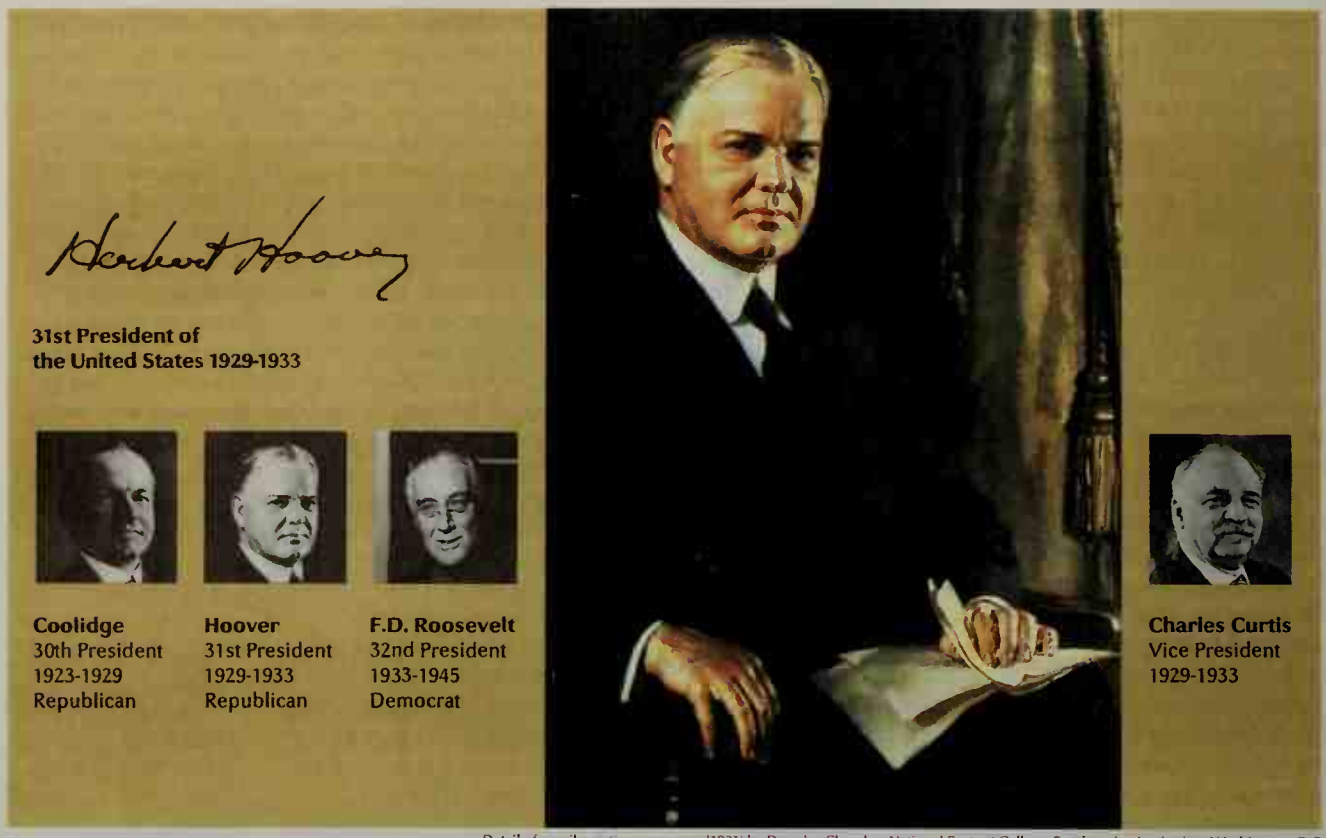
Hoosac tunnel, *HOO suhk,* is a 25,081-foot (7,645-meter) tunnel through the Berkshire Hills in western Massachusetts. It is on the main line of the Boston and Maine Railroad. The tunnel was begun in 1851 and completed in 1876, at a cost of 136 lives and about $14 million. The difficulty of the task forced private companies to give up the project. The state of Massachusetts completed the Hoosac tunnel. It marked the first American use of the power drill and of nitroglycerin for blasting. The state sold the tunnel to the railroad in 1884. The tunnel was enlarged in 1927. Boyd C. Paulson, Jr.

Hoosier Poet. See Riley, James Whitcomb.

Hoosier State. See Indiana.

Hooton, Earnest Albert (1887-1954), was an American physical anthropologist. His classification of the human races was at one time influential. Hooton worked chiefly on the fossil forms of early people, on the comparison of people with the other primates, and on physical types among criminals.

Hooton was born in Clemansville, Wis. He studied at the University of Wisconsin, and as a Rhodes Scholar at Oxford. He taught at Harvard University from 1913 until his death. Among his main books are *Up from the Ape* (1931) and *Man's Poor Relations* (1942). David B. Stout



Detail of an oil painting on canvas (1931) by Douglas Chandor, National Portrait Gallery, Smithsonian Institution, Washington, D.C.

Hoover, Herbert Clark (1874-1964), was President when the United States was swept by the Great Depression. Hoover had been a millionaire businessman and a successful public official before he became President. He entered the White House at a time of great prosperity in the United States. Americans expected him to lead them on to even better days. Then seven months after he took office, the stock market crashed and the Great Depression began.

President Hoover and many business leaders believed that prosperity would soon return to the United States. He appeared to act slowly in the emergency. But Hoover, a member of the Republican Party, was the first President to use the power of the federal government to fight a depression.

Hoover entered public life in 1914, after World War I began. He happened to be in London, and accepted the task of distributing food to the hungry Belgian people. President Woodrow Wilson then made him food administrator in the United States. For 19 months, Hoover supervised the production and distribution of food for American soldiers and civilians, and for the nation's allies.

In 1921, President Warren G. Harding appointed Hoover secretary of commerce. Hoover held this post until he ran for President in 1928. Hoover defeated Alfred E. Smith, the Democratic candidate, by the largest majority of electoral votes ever received by a candidate up to that time. Four years later, however, Franklin D. Roosevelt beat Hoover by an even larger majority of electoral votes.

Most people found Hoover shy and reserved. He had a quiet sense of humor and rarely laughed heartily. Hoover enjoyed fishing, hiking, and reading biographies and detective stories.

Early life

Boyhood. Herbert Hoover was the first President born west of the Mississippi River. He was born in West Branch, Iowa, on Aug. 10, 1874. One of his ancestors, Andrew Huber (or Hoover), had come to Pennsylvania from Germany in 1738. Huber moved to North Carolina, where his son John became a Quaker. John's descendants settled in Ohio, and moved to Iowa in 1853.

Herbert's parents, Jesse Clark Hoover and Hulda Randall Minthorn Hoover, had two sons and a daughter—Theodore, Herbert, and May. Jesse Hoover was a blacksmith and a dealer in farm equipment. Hulda Hoover, who was born in Canada, became a religious leader among the Quakers.

Hoover's father died in 1880 of heart trouble and other complications. He left a $1,000 life insurance policy and a little property. Hulda Hoover supported the family by preaching and sewing. She died of pneumonia and typhoid fever when Herbert was 9, and relatives reared the children. Most of the time, Herbert did not live with his brother and sister. He stayed with his uncle Allan Hoover near West Branch for about two years of his childhood.

Although an orphan, Herbert had a pleasant boyhood. He played in the woods and fished and swam in the streams. He picked potato bugs to earn money to buy fireworks and received a penny for every hundred bugs that he picked.

Education. In 1885, Hoover went to Newberg, Ore., to live with another uncle, Henry J. Minthorn. Hoover re-

Investors flocked to Wall Street after the crash.

The needy waited in bread lines to receive food.

Wide World

The world of President Hoover

The stock market crash of Oct. 29, 1929, wiped out the savings of thousands of investors and helped cause the Great Depression.
The Great Depression, a worldwide economic slump, caused thousands of businesses to fail. Millions of workers lost their jobs.
Naturalism, a literary movement featuring realistic settings and characters, became an important force in American drama. Leading naturalistic plays included Elmer Rice's *Street Scene* (1929) and Eugene O'Neill's *Mourning Becomes Electra* (1931).
New inventions included the first practical all-electronic television system, demonstrated in 1929, and the first reliable analog computer, built in 1930.
The Smoot-Hawley Tariff Act of 1930 raised United States tariffs to an all-time high.
The Statute of Westminster, passed by the British Parliament in 1931, recognized Canada as an independent nation.
Japan invaded Manchuria on Sept. 18, 1931. The Japanese attack helped bring on World War II.
The "Bonus Army," a group of unemployed World War I veterans, marched on Washington, D.C., in June 1932. They demanded payment of a bonus for their military service.
The Nazi Party, led by Adolf Hitler, steadily gained power in Germany during the early 1930's.
The Norris-La Guardia Act of 1932 was one of the first laws in the United States that encouraged labor union activity. The act forbade an employer to sue a worker for breaking a promise not to join a union.

ceived his secondary school education at Newberg College, a small Quaker academy of which his uncle was principal. Hoover worked to earn money whenever he could. One summer, he weeded onions at 50 cents a day. In 1888, Minthorn opened a real estate office in Salem, Ore. Hoover worked there as an office boy. He also studied algebra and geometry at a business college.

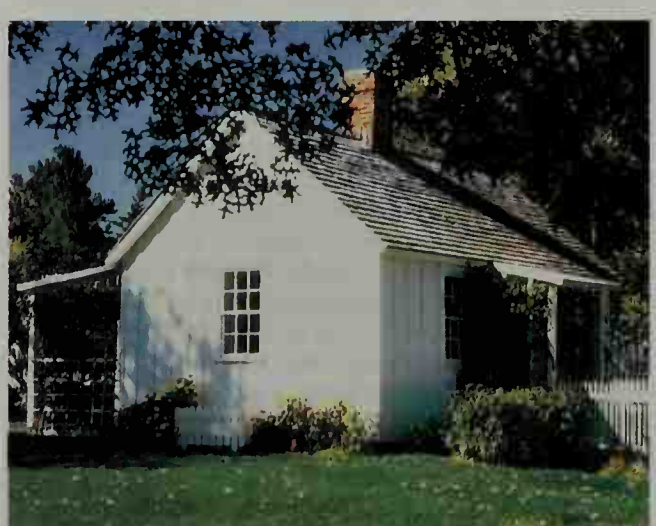
In 1890, Hoover became interested in engineering after talking with an engineer who visited his uncle's office. He decided to become a mining engineer. At the age of 17, Hoover enrolled in the first class of the newly founded Stanford University in Palo Alto, Calif. While in college, he managed a laundry agency and delivered newspapers to pay his expenses. He also worked as a part-time secretary for John Branner, head of the university's geology department. Hoover spent his summer vacations doing geological work in Arkansas, California, and Nevada. After graduation in 1895, he worked briefly as a miner in California.

Hoover's family. In the geology laboratory at Stanford, Hoover had met Lou Henry (March 29, 1874-Jan. 7, 1944), the daughter of a wealthy banker. They were married on Feb. 10, 1899, in Monterey, Calif.

Mrs. Hoover was a brilliant woman. She spoke several languages and had a deep interest in science, literature, and art. For about five years, the Hoovers spent their lei-

Important dates in Hoover's life

1874	(Aug. 10) Born in West Branch, Iowa.
1898	Became chief engineer of the Chinese Imperial Bureau of Mines.
1899	(Feb. 10) Married Lou Henry.
1908	Established his own engineering firm.
1914	Headed the Commission for Relief in Belgium.
1917	Named United States food administrator.
1921	Appointed secretary of commerce.
1928	Elected President of the United States.
1932	Defeated for reelection as President.
1944	Mrs. Lou Henry Hoover died.
1947	Named chairman of the Hoover Commission.
1954	The Herbert Hoover Foundation was established.
1964	(Oct. 20) Died in New York City.



Herbert Hoover Library

Hoover's birthplace stands in West Branch, Iowa. His grandparents were among the Quakers who settled the town in the 1840's. Hoover is buried on a rise overlooking the small house.

White House Historical Association

Lou Henry Hoover, Hoover's wife, was a brilliant woman who wrote articles for many scholarly publications. This portrait was painted by Lydia Field Emmett, an American artist.

sure time translating a famous old book on mining from Latin into English. They received special degrees from Stanford in recognition of their work. After her husband became President, Mrs. Hoover wrote articles for scientific and historical publications.

The Hoovers had two sons. Herbert, Jr. (1903-1969), also became a mining engineer. He served as undersecretary of state during President Dwight D. Eisenhower's first term. Allan (1907-1993) became a director of a lead- and zinc-mining company and of other businesses.

Engineer and businessman. In 1896, Hoover began his career in the San Francisco office of Louis Janin, a well-known mining engineer. The next year, a London company wanted an engineer to manage its gold mines in Australia. Hoover, then 23, got the job on Janin's recommendation. Late in 1898, after less than two years in Australia, Hoover accepted the post of chief engineer for the Chinese Imperial Bureau of Mines.

The Hoovers spent their honeymoon sailing from California to China. While her husband made prospecting trips and directed engineering projects, Mrs. Hoover learned to speak Chinese. The Boxer Rebellion began in 1900, and Hoover supervised the construction of defenses for the foreign settlement in Tianjin. During the two-month Boxer siege of the settlement, he directed the distribution of food and other supplies. See **Boxer Rebellion.**

The Chinese government discontinued its Bureau of Mines after the rebellion. Hoover went to London and helped organize a private company to develop the Chinese mines. In 1901, he returned to China as the company's general manager. He resigned after a few months and went to London as a partner in the mining company with which he had been associated since 1897. In 1908, Hoover established his own engineering firm. Hoover reorganized mines in many parts of the world. By 1914, he had become a millionaire.

Political and public activities

Food administrator. Hoover was in London in 1914. The start of World War I had stranded thousands of Americans in Europe. United States officials in London asked Hoover to aid these people. He organized a committee that helped about 120,000 Americans get home. In August 1914, the U.S. ambassador in London asked Hoover to organize food relief for Belgium. German troops had conquered the country, and many Belgians were not getting enough food. Hoover set up the Commission for Relief in Belgium. From October 1914 to April 1917, he gathered and distributed food, and helped raise relief funds. His commission saved many thousands of lives.

The United States entered the war in April 1917. President Wilson asked Hoover to head the United States Food Administration. Hoover was given broad powers over the prices, production, and distribution of food. Americans responded eagerly to his campaign to save food for people in war-torn Europe. The term "Hooverize" came to mean saving and doing without various foods. Meatless and wheatless days were observed. After the war ended in 1918, Hoover returned to Europe to direct the feeding of millions of people. He had become internationally famous.

Secretary of commerce. As early as 1919, many Americans thought Hoover should be President. Both Republican and Democratic political leaders wanted him as a candidate in 1920. Hoover announced that he was a Republican but did not do well in the primary

United Press Int.

As head of the U.S. Food Administration during World War I, Hoover, *right,* directed efforts to save food for hungry Europeans. The term *Hooverize* came to mean *economize.*

elections. In 1921, President Warren G. Harding named Hoover secretary of commerce. Hoover held this office under Harding and President Calvin Coolidge.

As secretary of commerce, Hoover again showed his great skill as an administrator and planner. He reorganized the Department of Commerce and rapidly expanded its work. He became interested in so many activities that one official called him "Secretary of Commerce and Under Secretary of everything else." Hoover set up many conferences to consider such problems as industrial production, labor relations, child welfare, foreign trade, and housing. He also brought order into radio broadcasting, promoted commercial aviation, and helped end the 12-hour workday in the steel industry.

Election of 1928. President Coolidge announced in August 1927 that he did not "choose to run" for reelection. In February 1928, Hoover became a candidate for the Republican presidential nomination. The party's national convention nominated him on the first ballot, and chose Senator Charles Curtis of Kansas for Vice President. The Democrats nominated Governor Alfred E. Smith of New York for President and Senator Joseph T. Robinson of Arkansas for Vice President.

In the election campaign, Hoover spoke hopefully about increasing prosperity. He observed, "The slogan of progress is changing from the full dinner pail to the full garage." Prohibition became a major issue of the campaign. Smith wanted to repeal Amendment 18 of the Constitution, which prohibited the sale of alcoholic drinks. Hoover called prohibition an "experiment noble in motive." Millions of Americans felt that the Republicans would keep the nation prosperous. In addition, many voters opposed Smith because he was a Roman Catholic. Hoover carried 40 of the 48 states and received 444 electoral votes to only 87 for Smith.

After the election, President-elect Hoover made a good-will tour of Latin America. His trip helped lay the foundation for the "Good Neighbor Policy" of the Franklin D. Roosevelt era.

Hoover's Administration (1929-1933)

Champion of prosperity. President Hoover expected prosperity to continue. "Ours is a land rich in resources . . . ," he said in his inaugural address. "In no nation are the fruits of accomplishment more secure."

During his campaign, Hoover had promised to help the farmers, who had not shared in the general prosperity. To fulfill his promise, he called a special session of Congress in April 1929. In June, Congress passed the Agricultural Marketing Act. This law established the Federal Farm Board, which promoted farm cooperatives and purchased farm surpluses. Hoover also wanted to raise tariffs on farm products to reduce foreign competition. But the Smoot-Hawley bill, which Congress passed in 1930 and Hoover signed, went too far and raised the tariff on many nonfarm products as well. The increased tariffs seriously damaged America's foreign trade and contributed to the depression.

The Great Depression. The United States had been building up to a crash for a long time. Other groups besides farmers had not shared in the prosperity of the 1920's. In the coal-mining and textile-manufacturing industries, for example, working conditions were poor and wages low. The economy was also weakened by widespread buying on credit. Thousands of people had borrowed money to pay for stocks. Stock prices soared to record heights. Then, in October 1929, the stock market crashed. The Great Depression had begun.

At first, few people believed that the depression would affect the entire nation. Many thought the stock market would recover in a few weeks or months. But by the end of 1929 the crash had caused losses estimated at $40 billion. The values of stocks listed on the New York Stock Exchange had dropped 40 percent. Fortunes had been wiped out. Thousands of workers had lost their jobs.

Hoover told the people they had no reason for fear. He called business leaders, industrialists, and labor leaders together for conferences. All these groups promised to cooperate in an effort to keep wages stable and to avoid strikes. But economic conditions grew worse. By 1932, more than 12 million Americans were out of work. Factories closed and many banks failed. Thousands of people lost their homes because they could not keep up their mortgage payments. Many families lived in clumps of shacks that became known as *Hoovervilles*.

The Great Depression affected other nations, too. Germany could not pay the 1931 installment on its World War I reparations. Other countries also had difficulty paying their war debts. At Hoover's suggestion, a one-year postponement of international debt payments was negotiated. This postponement became known as the *Hoover Moratorium*.

Antidepression action. Hoover was reluctant to interfere with the American economy. He called the depression "a temporary halt in the prosperity of a great people." At first, he depended on business companies and industries to solve their own problems and to take part in national stabilization efforts. But in 1932, at Hoover's request, Congress passed several laws enabling the government to help business. One of these laws set up the Reconstruction Finance Corporation (RFC). The RFC loaned money to banks and other firms to keep them from going bankrupt.

Hoover had believed that the states and local communities should provide relief for jobless workers. But it became clear that the unemployed needed much more assistance. Congress authorized the RFC to lend up to $300 million to the states for relief. Other laws provided credit for homeowners and farmers, and improved court practices and bankruptcy procedures.

Hoover supported many public works and conservation programs. In part, these projects were designed to help provide jobs. During his Administration, the Bureau of Reclamation started to build Hoover Dam on the Colorado River. The government worked to develop

Hoover's election

Place of nominating convention	Kansas City
Ballot on which nominated	1st
Democratic opponent	Alfred E. Smith
Electoral vote*	444 (Hoover) to 87 (Smith)
Popular vote	21,411,991 (Hoover) to 15,000,185 (Smith)
Age at inauguration	54

*For votes by states, see Electoral College (table)

Vice president and Cabinet

Vice president	*Charles Curtis
Secretary of state	Henry L. Stimson
Secretary of the treasury	*Andrew W. Mellon
	Ogden L. Mills (1932)
Secretary of war	Dwight F. Davis
	James W. Good (1929)
	Patrick J. Hurley (1929)
Attorney general	John G. Sargent
	William D. Mitchell (1929)
Postmaster general	Harry S. New
	Walter F. Brown (1929)
Secretary of the Navy	Curtis D. Wilbur
	Charles F. Adams (1929)
Secretary of the interior	Roy O. West
	Ray L. Wilbur (1929)
Secretary of agriculture	William M. Jardine
	Arthur M. Hyde (1929)
Secretary of commerce	William F. Whiting
	Robert P. Lamont (1929)
	Roy D. Chapin (1932)
Secretary of labor	James J. Davis
	William N. Doak (1930)

*Has a separate biography in *World Book*.

inland waterways for navigation and flood control. It added about 3 million acres (1,200,000 hectares) to national parks and monuments and enlarged the national forests. It built more than 800 public buildings and helped states build about 37,000 miles (59,500 kilometers) of major highways.

The "Bonus Army." Unemployed workers staged hunger marches and demonstrations in several cities during the early 1930's. The most famous was that of the Bonus Expeditionary Force, an "army" of World War I veterans. The bonus law of 1924 had given every veteran a certificate that was payable in 1945. But now the veterans wanted the bonus paid immediately. The House of Representatives passed a bill to meet their demand. In June 1932, about 15,000 veterans from many states marched on Washington, D.C., to bring pressure on the Senate to pass the bill. Crowds of veterans stood on the Capitol steps, marched around the building, and visited senators. But the Senate defeated the bonus bill. Efforts to clear the veterans from public buildings led to a riot, and Hoover used troops to drive the veterans out of Washington. He opposed the bonus because he did not believe it was financially sound.

Foreign policy. Under Hoover, the United States moved toward cooperation with other nations on such problems as arms control. In the London Naval Treaty of 1930, the United States, Britain, and Japan agreed to limit the number of their fighting ships. Hoover proposed a reduction in land weapons in 1932, but other countries refused to cooperate.

Hoover worked to improve relations with Latin America. He brought home the marines who had been helping to maintain peace in Nicaragua since 1912. The United States did "not wish to be represented abroad in such a manner," Hoover said. He made an agreement with Haiti under which U.S. troops would be withdrawn from that country in 1934. The troops had been sent to Haiti in 1915 to end a series of revolutions.

In 1931, Japanese forces invaded Manchuria. China protested to the League of Nations, and a League commission condemned Japan as an aggressor. Hoover declared that the United States would not recognize territorial gains made in violation of the Kellogg-Briand Pact (see **Kellogg-Briand Pact**).

Life in the White House. President and Mrs. Hoover gave the Executive Mansion a "new look." They decorated it with souvenirs and art objects that they had collected during years of world travel. A large cage of canaries was placed in the second-floor corridor. Around the cage, Mrs. Hoover put bamboo furniture and grass rugs from South America.

The Hoovers entertained frequently but avoided personal publicity as much as possible. Mrs. Hoover, a gracious hostess, hired three secretaries to help her prepare invitations. Once she invited 200 guests for dinner. Something went wrong, and 500 people arrived. The White House staff had to hurry out to neighborhood stores and buy more food.

In summer, President and Mrs. Hoover often escaped from the heat by vacationing in the Blue Ridge Mountains of Virginia. The president enjoyed fishing for trout in the Rapidan River. He built a summer home in the mountains and later gave it to the Shenandoah National Park. Hoover also exercised by playing a daily medicine ball game with a group of friends. The game usually began on the White House lawn at 7 a.m. The players included newsmen and government officials, and were called the "medicine ball cabinet."

Election of 1932. The Republicans had little hope of winning the 1932 presidential election. They renominated Hoover and Vice President Curtis but did not support the candidates vigorously. The Democrats nominated Governor Franklin D. Roosevelt of New York for president. They nominated Speaker of the House John N. Garner of Texas for vice president.

The Democrats attacked Hoover's leadership in the depression. Roosevelt called for a "new deal" for the American people. He promised to balance the budget, bring relief to the unemployed, help the farmers, and end prohibition. Hoover defended his record, promised economy in government, and opposed inflation. In the election, Roosevelt carried 42 of the 48 states. He won by an electoral vote margin of 472 to 59.

During Hoover's last four months in office, bank failures and unemployment increased. Congress paid little attention to his recommendations, and President-elect Roosevelt refused to promise support for Hoover's policies. Amendment 20 to the Constitution, known as the "lame duck amendment," became law in January 1933. It provided that a president's term of office should end on January 20 instead of March 4, but this provision did not go into effect until October 1933.

Elder statesman

After leaving the presidency, Hoover spent much time traveling, reading, speaking, and writing. He continued to develop the Hoover Institution on War, Revolution, and Peace that he had founded at Stanford in 1919. He and his wife moved from Palo Alto, Calif., to New York City. Mrs. Hoover died there on Jan. 7, 1944.

Hoover published *The Challenge to Liberty* in 1934. It was an attack on President Roosevelt's New Deal program. In 1940, during the first Russo-Finnish War, Hoover headed a committee that collected relief funds for Finland. He published *The Problems of Lasting Peace* (1942) and *The Basis of Lasting Peace* (1945). After

United Press Int.

As chairman of the Hoover Commission, Hoover recommended ways to improve the administration of the U.S. government. He submitted his final report, *shown here,* at age 81.

World War II, Democratic President Harry S. Truman named Hoover chairman of the Famine Emergency Commission. In this post, Hoover surveyed the food needs of many nations. He went to Europe in 1947 to report to President Truman on relief needs.

Also in 1947, Hoover became chairman of the Commission on Organization of the Executive Branch of the Government (called the *Hoover Commission*). Commission proposals that were adopted streamlined the government and cut costs (see **Hoover Commission**).

Hoover wrote his *Memoirs* in three volumes (1951-1952) and *The Ordeal of Woodrow Wilson* (1958). By 1961, he was a director or trustee of nine private educational, scientific, and charitable institutions. The Herbert Hoover Library, which houses most of his official papers, was dedicated in West Branch in 1962. He completed his four-volume work, *An American Epic,* in 1964.

Hoover gave all his income from government work, including his pension, to charity and to public service. His services to government and society restored Hoover to popular favor. He lived longer after leaving the White House than any other former president. He died on Oct. 20, 1964, at age 90 in New York City. The country mourned him as a great American. Hoover was buried near his birthplace in West Branch. Ellis W. Hawley

Related articles in *World Book* include:

Great Depression (Hoover's policies)
Hoover Commission
Iowa (Places to visit)
President of the United States
Prohibition
Roosevelt, Franklin Delano (Return to politics)

Outline

I. **Early life**
   A. Boyhood
   B. Education
   C. Hoover's family
   D. Engineer and businessman
II. **Political and public activities**
   A. Food administrator
   B. Secretary of commerce
   C. Election of 1928
III. **Hoover's Administration (1929-1933)**
   A. Champion of prosperity
   B. The Great Depression
   C. Antidepression action
   D. The "Bonus Army"
   E. Foreign policy
   F. Life in the White House
   G. Election of 1932
IV. **Elder statesman**

Questions

How did Hoover become interested in engineering?
Why was Hoover in London when World War I began?
How did Hoover serve America during World War I?
What did the term "Hooverize" mean?
How did Hoover describe Prohibition?
How did the Reconstruction Finance Corporation try to help business during the Great Depression?
Why did Hoover oppose the veterans' bonus?
What was the "medicine ball cabinet"?
What did the Hoover Commission do?

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Holford, David M. *Herbert Hoover.* Enslow, 1999. Younger readers.
Nash, George H. *The Life of Herbert Hoover.* Norton, 1983- . Multivolume work.
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Hoover, J. Edgar (1895-1972), served as director of the Federal Bureau of Investigation (FBI) for 48 years. He held the office from 1924 until his death. Hoover built the FBI into one of the world's outstanding law-enforcement agencies. But a congressional investigation after Hoover's death raised questions about some of his actions.

The Bureau of Investigation, which received its present name in 1935, was corrupt and disorganized when Hoover became director. Hoover reformed the agency, largely by appointing people for their ability and promoting them for good performance. He established the world's largest fingerprint file, a crime laboratory, and a training academy. Hoover became famous in the 1930's, when the FBI tracked down many well-known criminals. During and after World War II (1939-1945), the bureau smashed several foreign spy rings.

In 1975, congressional investigators disclosed that Hoover had abused his power a number of times. For example, he tried to win favor with several presidents by gathering scandal about some of their political opponents. Under Hoover, the FBI also violated the civil rights of many critics of government policies.

John Edgar Hoover

Wide World

J. Edgar Hoover

was born in Washington, D.C. He graduated from the George Washington University law school in 1917 and joined the United States Department of Justice that same year. George T. Felkenes

See also **Federal Bureau of Investigation.**

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Hoover Commission was the popular name of two commissions that recommended ways to improve the administration of the United States government. Their official name was Commission on Organization of the Executive Branch of the Government. Former President Herbert C. Hoover headed the two commissions. The first commission, created by Congress in 1947, completed its report in 1949. The second commission, set up in 1953, made its recommendations in 1955.

The federal government adopted about 74 percent of the first commission's 273 proposals. It accepted about 64 percent of the second commission's 314 recommendations. The proposals of the two commissions were estimated to have saved the government $7 billion and $3 billion, respectively. They led to setting up the Department of Defense and the Department of Health, Education, and Welfare (now the Department of Health and Human Services). Ellis W. Hawley

Hoover Dam is one of the highest concrete dams in the world. It stands in the Black Canyon of the Colorado River. The dam is part of the Boulder Canyon Project. The project also includes a hydroelectric power plant and a reservoir. It controls floods of the Colorado River and supplies water and electric power for much of the Pacific Southwest. The project is on the Arizona-Nevada border, about 25 miles (40 kilometers) southeast of Las Vegas, Nevada. For the location of Hoover Dam, see **Arizona** (physical map).

Hoover Dam is 726 feet (221 meters) high and 1,244 feet (379 meters) long. Elevators descend the equivalent of 44 stories into the dam and still do not reach its base. The concrete base is 660 feet (200 meters) thick. It contains about 4 $\frac{1}{2}$ million cubic yards (3.4 million cubic meters) of concrete, enough to pave a two-lane highway from New York City to San Francisco.

Lake Mead, the dam reservoir, is one of the world's largest artificially created bodies of water. It is about 115 miles (185 kilometers) long and 589 feet (180 meters) deep. The reservoir can store approximately 28 million acre-feet (35 billion cubic meters) of water.

Water falling through the huge turbines of the dam generates electric power, which is sold to industries and to cities in the Pacific Southwest. The power plant has a capacity of about 1 $\frac{1}{2}$ million kilowatts. Several power lines lead from the Boulder Canyon Project to the Los Angeles area of California. Generators at the dam supply much of the power consumed in Arizona, Nevada, and southern California. Water from Lake Mead can irrigate about 1 million acres (400,000 hectares) of farmland in the three-state area. The reservoir also supplies water for cities in southern California through an aqueduct that is 240 miles (386 kilometers) long.

The need for a dam on the Colorado River was apparent in the early 1900's. Floods were causing a large amount of damage in the Palo Verde Valley and in the Imperial Valley. Extensive levees were built, but crops died when the river ran too low to meet the area's irrigation needs.

In 1928, Congress authorized the Boulder Canyon Project. The Bureau of Reclamation designed the dam and supervised its construction. The entire project cost about $385 million. The dam itself cost more than $175 million. Hoover Dam was completed in 1936.

In 1931, the dam was named Hoover Dam to honor President Herbert Hoover. After he left office in 1933, the Department of the Interior began to call the dam Boulder Dam or Boulder Canyon Dam. Congress officially named it Hoover Dam in 1947. Edward C. Pritchett

See also **Dam; Lake Mead; Nevada** (picture).

Hop is the name of several species of vines. One species, the *common hop,* is grown for its papery, yellowish-green flowers, which are used in brewing beer. The flowers, also called *hops,* grow in conelike clusters that measure from 1 to 4 inches (2.5 to 10 centimeters) in length. Tiny glands in the flowers and on leaflike structures called *bracts* contain various oils and *resins* (sticky substances). These materials prevent the growth of bacteria in beer and give the beverage its bitter taste.

Hopvines may grow as long as 25 feet (8 meters) in a single growing season. The vines die in the fall. But the *rhizomes* (underground stems) of the plants continue to live, and they produce new vines the next spring.

Hops grow in a wide range of climates and soils. The chief hop-growing countries are Germany and the United States. Washington, Oregon, and Idaho lead the states in the production of hops.

WORLD BOOK illustration by Lorraine Epstein

Hops produce male and female flowers on different plants. The female flowers in the lower illustration are used to brew beer.

Growers plant hop rhizomes in mounds 6 to 8 feet (1.8 to 2.4 meters) apart. The vines are supported with poles or trellises to keep them from spreading on the ground. Such supports allow the plants to be placed closer together, thus increasing the yield of each unit of land.

Hops are harvested in late summer or early autumn. Usually, workers cut the vines by hand and place them in picking machines that separate the hops from the vines. The hops are then cleaned, dried in ovens, and pressed into bales for shipment or storage.

David S. Seigler

Scientific classification. Hops belong to the cannabis family, Cannabaceae. The scientific name for the common hop is *Humulus lupulus.*

See also **Brewing** (Boiling).

Hope, Bob (1903-), is a popular American comedian and actor. He won fame for his fast-paced wisecracks in movies, on radio and TV, and on the stage.

Hope was born in London. His given and family name was Leslie Townes Hope. He moved to Cleveland with his family at the age of 4. Hope became a vaudeville performer in the early 1920's and made his Broadway debut in 1927. He became a star in the musical comedy *Roberta* (1933). During the 1930's and 1940's, Hope starred in a popular radio show.

NBC

Bob Hope

Hope has appeared in more than 50 motion pictures. His first feature film was *The Big Broadcast of 1938,* in which he first sang "Thanks for the Memory." This song became Hope's theme song. He co-starred with Bing Crosby and Dorothy Lamour in *Road to Singapore* (1940) and six later "Road" comedies. Hope gave many performances for charity and traveled worldwide to entertain the armed forces. He received five special Academy Awards for his humanitarian activities and for his services to the film industry. He has also written several humorous books and an autobiography, *The Road to Hollywood* (1977).

Rachel Gallagher

Hope, John (1868-1936), was an African American educator. In 1906, he became the first black president of what is now Morehouse College in Atlanta. The four previous presidents of this black college had been white.

Hope headed Morehouse until 1929, when he became president of Atlanta University. That same year, he helped found the Atlanta University Center, which consisted of three schools—Atlanta, Morehouse, and Spelman College. Throughout his career, Hope encouraged African Americans to attend college rather than vocational school. His policy opposed that of the leading black educator Booker T. Washington, who believed blacks could benefit as much from job training as from a college education.

Hope was born in Augusta, Georgia, and received his B.A. degree from Brown University. In 1898, he became a professor of classics at Atlanta Baptist College, whose name was changed to Morehouse College in 1913. After Hope's death, the National Association for the Advancement of Colored People (NAACP) awarded him the Spingarn Medal. Alton Hornsby, Jr.

Hopewell Indians. See Mound builders.

Hopi Indians, *HOH pee,* are one of the Pueblo Indian tribes. According to the 1990 United States census, there are about 11,000 Hopi. About 7,000 live on the Hopi reservation in Arizona. They live in 11 villages on or near three high *mesas* (tablelands). One village, Oraibi, is one of the oldest continuously inhabited villages in the United States. It was founded about 800 years ago.

Like their early ancestors, many Hopi grow crops on plots of valley land. Some Hopi earn additional income by making and selling baskets, pottery, silver jewelry, and *kachina* dolls. The carved wooden dolls represent messengers sent by the gods. Religious ceremonies play an important part in the life of the Hopi. At certain times of the year, Hopi men dress as kachinas and perform dances in the village square or in underground structures called *kivas.* LaVerne Masayesva-Jeanne

Related articles in *World Book* include:

Indian, American (illustration: Indian ways of life)
Kachina
Navajo Indians
Pueblo Indians
Snake dance

Hopkins, Gerard Manley (1844-1889), ranks as a major poet of Victorian England, though his work remained almost unknown until 1918, when it was first published. Hopkins wrote most of his poetry in *sprung rhythm,* which emphasizes the natural rhythms of speech. He filled his verse with alliteration and unusual word combinations. His poems, which are especially effective when read aloud, include the long and complex "The Wreck of the *Deutschland.*"

Hopkins was born in Essex. In 1863, he entered Oxford University. There, he experienced a spiritual crisis that led him to join the Roman Catholic Church in 1866. Hopkins entered the Jesuit order in 1868 (see **Jesuits**). He then stopped writing and burned the manuscripts of his poems. Hopkins returned to writing in 1875 after being encouraged by a Jesuit superior. He was ordained a priest in 1877. K. K. Collins

See also **Poetry** (Sounds).

Hopkins, Harry Lloyd (1890-1946), was President Franklin D. Roosevelt's most influential adviser. He was one of Roosevelt's top assistants and closest friends. He helped Roosevelt create and carry out the New Deal recovery program during the Great Depression.

Hopkins was born in Sioux City, Iowa. After graduating from Grinnell College in Iowa in 1912, he became a social worker in New York City. The Great Depression began in 1929. Hopkins showed skill in managing economic relief efforts. In 1931, Roosevelt, then governor of New York, named him to head the state's relief program.

Roosevelt became president in 1933. Hopkins headed the Federal Emergency Relief Administration (FERA) from 1933 to 1938, the Works Progress Administration (WPA) from 1935 to 1938, and the Department of Commerce from 1938 to 1940. In 1941, during World War II, Hopkins directed the Lend-Lease program, which provided United States aid to countries fighting the Axis nations. During the war, Hopkins also represented Roosevelt and his successor, Harry S. Truman, at important meetings with Allied leaders. James S. Olson

Hopkins, Johns (1795-1873), was an American merchant, financier, and philanthropist. He left $7 million to establish Johns Hopkins University and Johns Hopkins Hospital. He was born in Anne Arundel County, Maryland, and made a fortune as a wholesale grocer in Baltimore. Later, he helped organize the Baltimore and Ohio Railroad. He also helped Baltimore with loans during the Civil War and the financial panic of 1873. Hopkins was a Quaker and an abolitionist. Robert H. Bremner

Hopkins, Stephen (1707-1785), an American statesman, was a Rhode Island signer of the Declaration of Independence in 1776. Beginning in 1732, Hopkins served several terms in the Rhode Island Legislature. He became chief justice of the Superior Court of Rhode Island in 1751 and, in 1755, was elected the colony's governor. Hopkins wrote an important pamphlet called "The Rights of Colonies Examined" (1765), which criticized British policy in the American Colonies. He also headed major committees that opposed British colonial measures. From 1774 to 1776, he was a delegate to two Continental Congresses. Hopkins was born in Providence, Rhode Island. Jack N. Rakove

Hopkinson, Francis (1737-1791), a New Jersey signer of the Declaration of Independence, was an American statesman, artist, writer, lawyer, and judge. He also claimed credit for designing the American flag, and most scholars support the claim. His most important writings included poetry, essays, and political *satires* (comedies).

Hopkinson was born in Philadelphia. He enrolled in the Philadelphia Academy in 1751 and received a diploma from the College of Philadelphia in 1757. He then practiced law in Philadelphia and in Bordentown, New Jersey. In 1776, he was elected to the Continental Congress and the Continental Navy Board. In 1778, he served as a commissioner in the Continental Loan Office. He was judge of the United States Court of the Eastern District of Pennsylvania from 1789 until his death. Jack N. Rakove

Hopper, Edward (1882-1967), was an American painter whose pictures of New York City and life in small New England towns are among the finest realistic works of his time. Hopper depicted ordinary scenes such as city streets and country roads, restaurants, movie theaters, lighthouses, storefronts, and bedrooms. Through these everyday subjects, he expressed feelings of loneliness and isolation. There are no people in many of his works. Even the paintings that show couples suggest melancholy and a lack of communication.

Hopper achieved a sense of loneliness and finality in his paintings through strong patterns of light and shade. The omission of distracting detail and the geometric arrangement of the compositions give Hopper's paintings an abstract power.

Hopper was born in Nyack, New York, and lived in New York City. He worked as a commercial artist and illustrator for years. He was unable to concentrate fully on painting until he was past 40. Pamela A. Ivinski

See also Drawing (picture: A charcoal drawing).

Hopper, Grace Murray (1906-1992), was an American computer scientist. During the 1950's, she directed the work that eventually led to COBOL (*CO*mmon *B*usiness *O*riented *L*anguage), one of the most widely used computer programming languages. A programming language is the set of symbols, letters, words, and numbers used for giving instructions to a computer. Early programming languages were hard to understand and learn. Hopper believed that programming languages should be more like everyday language so that many people could use computers. To help make this possible, Hopper developed a system of translating everyday language into instructions that a computer can process.

Hopper was born in New York City. She graduated from Vassar College in 1928 and received a Ph.D degree in mathematics from Yale University in 1934. Hopper joined the United States Navy in 1943, during World War II. Her work on computers began in the Navy and continued in private industry after 1949. Hopper retired from the Navy in 1986. Frank Williamson, Jr.

Horace (65-8 B.C.) was one of the greatest poets of ancient Rome. He is most famous for *Odes,* a collection of short, songlike poems. Some are personal poems about love, friendship, and natural beauty. Others express Horace's love for his country and his religion, using myths and tales of national heroes. See **Ode.**

Horace also wrote a more conversational kind of poetry called *satires* that make gentle fun of human weaknesses. The two books of *Satires* and a collection of odelike poems called *Epodes* are Horace's earliest poetry. He later wrote verse letters to his friends about life and poetry. These letters make up the two collections called *Epistles.* See **Satire; Epistle.**

Horace was born in southern Italy. His full name in Latin, the language of ancient Rome, was Quintus Horatius Flaccus. His father, though a former slave, gave Horace an excellent education in Rome and Athens. Horace left his studies in Athens to join the army of Marcus Junius Brutus during Rome's civil war. After Brutus was defeated in 42 B.C., Horace returned to Rome. He became a civil servant and began to write poetry. Gaius Maecenas, a wealthy patron of the arts, gave Horace an estate to support him so he was free to spend his time writing poetry. Elaine Fantham

See also **Latin literature** (The Augustan Age).

Horatius, *huh RAY shuhs,* was a legendary Roman hero. Thomas Macaulay's *Lays of Ancient Rome* relates the story of Horatius' defense of the bridge over the Tiber River. When the last king of Rome was overthrown, he went to the Etruscans for help. The Etruscan army advanced to the bank of the Tiber River across from Rome. With two companions, Lartius and Herminius, Horatius held back the Etruscans while the Romans chopped down the bridge behind them. His friends ran back just in time, but Horatius remained alone until the bridge fell. Then, he jumped into the rushing Tiber and swam to safety. The people gave Horatius many gifts and erected a statue in his honor for his bravery in saving the city. Herbert M. Howe

Horeb. See **Mount Sinai.**

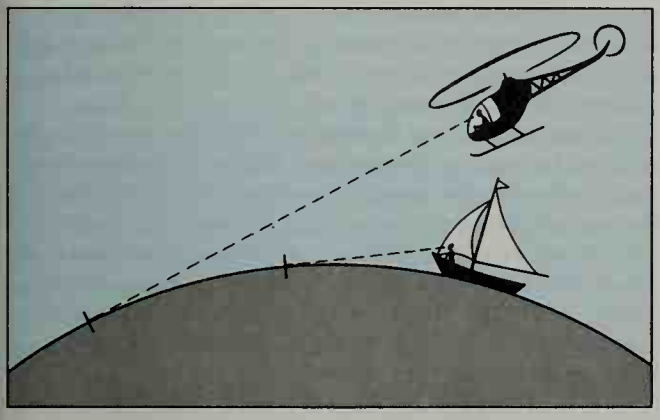
Horehound is the name given to several plants in the mint family. The *common,* or *white, horehound* grows in the countryside and along the roads throughout Europe and northern Asia. It now also grows in both North and South America. The plant grows from 1 to 3 feet (30 to 91 centimeters) high. Many cottony white hairs cover it and give it a whitish appearance. The flowers are small and almost white. The leaves and stems have a pleasant odor and a bitter taste. Cough medicines and candy are

made from the leaves and stems. The *black,* or *fetid,* horehound, also used to make medicine, is an English flower that looks like the white horehound.

Scientific classification. Horehound belongs to the mint family, Lamiaceae or Labiatae. The scientific name for white horehound is *Marrubium vulgare.* Black horehound is *Ballota nigra.* Lyle E. Craker

Horizon is the distant, curved line where the earth and sky seem to meet. Most people near the ground on land cannot see to the horizon because buildings, trees, or mountains block their view. But a person on-board a ship can see all the way to the horizon on a clear day.

The horizon seems nearer to a person standing at sea level than to a person in an airplane or on a mountain peak. This is because the person up high can see farther over the curvature of the earth than the person at sea level. The horizon is about $2\frac{1}{2}$ miles (4 kilometers) away to someone at sea level. But it is 98 miles (158 kilometers) from someone in an airplane or on a mountain 1 mile (1.6 kilometers) above sea level.



The distance to the horizon depends upon the position of the observer. The horizon the pilot sees is farther away than the horizon seen by the sailor, who is directly below the pilot.

Astronomers and navigators have several technical meanings for horizon. The *visible* horizon is the imaginary line where the earth and sky seem to meet. The *astronomical,* or *sensible,* horizon refers to the imaginary line where the *celestial sphere* (curved dome of the sky) meets the imaginary level plane through a person's eye. Because the earth is curved, the visible horizon is slightly below the astronomical horizon. The angle between an observer and the two horizons is called the *dip.* Thomas J. Balonek

Hormone, *HAWR mohn,* is any of a number of chemical substances produced within an animal or a plant. A hormone is produced in one part of an organism, but it causes an effect in a different part. Thus, hormones serve as a means of communication among various parts of an organism. They act as "chemical messengers" that help these parts function in a coordinated way.

The word *hormone* comes from a Greek word that means *to set in motion.* In human beings and other animals, hormones control such body activities as growth, development, and reproduction. In plants, hormones regulate many aspects of growth. If an organism fails to produce the proper kind or amount of hormones, serious disturbances—or even death—may result. For example, giants and dwarfs—among both animals and plants—can result from faulty hormone production.

In 1902, scientists found the first definite evidence of the existence of hormones. That year, British researchers discovered that a chemical substance controlled certain activities involved in digestion. Since then, scientists have identified more than 30 hormones produced by the human body. They also have developed ways of extracting hormones from living tissue and techniques for manufacturing them in the laboratory.

Human hormones

Most hormones in the human body are produced by organs called *endocrine,* or *ductless, glands.* The major endocrine glands include the two adrenal glands, the pituitary gland, the four parathyroid glands, the sex glands, and the thyroid gland. A few hormones are produced by endocrine tissue present in organs that are not primarily endocrine glands. Such organs include the stomach and pancreas. See **Gland.**

The endocrine glands secrete hormones into the blood, which carries them throughout the body. After a hormone arrives at its *target,* the organ or tissue it affects, it causes certain actions to occur.

Hormones regulate a variety of body functions. They may be grouped according to the functions they control. These functions include the way the body uses food; growth; sex and reproduction; the regulation of the composition of the blood; the reaction of the body to emergencies; and the control of hormones themselves.

Metabolic hormones regulate the various steps in *metabolism,* the process by which the body converts food into energy and living tissue. For example, the endocrine tissue of the stomach and small intestine secretes a number of *digestive hormones.* These hormones control the secretion of digestive juices, which break down food into simple substances that can be used by the body.

After molecules of digested food enter the bloodstream, other hormones control their use by the cells of the body. For example, the hormones *insulin* and *glucagon,* both secreted by the pancreas, regulate the amount of sugar available to the cells. Insulin enables cells to use sugar from the blood. If the pancreas secretes too little insulin, a serious disease called diabetes mellitus results. Glucagon causes the liver to release additional sugar into the blood.

Two hormones produced by the thyroid gland—*thyroxine* and *triiodothyronine*—control the rate at which the cells use food to release energy. Overproduction of these hormones results in many physical and emotional disturbances, including excitability, muscular weakness, rapid pulse and respiration, and weight loss. Underproduction causes such symptoms as low body temperature, mental and physical sluggishness, and weight gain. By controlling the production of energy, these hormones regulate the way in which the body uses food in building new tissue. Thus, they play a major role in the creation of new proteins by the body cells.

Thyroid hormones also play a role in regulating growth and development. A deficiency of these hormones during fetal development can result in *cretinism,* a form of dwarfism and mental retardation (see **Cretinism**).

Other hormones also control the way cells use food to build new tissue. The *glucocorticoids* are a group of hormones that function primarily in regulating the metabolism of *carbohydrates* (sugars and starches), fats, and proteins. They control the processes by which the body converts digested proteins into carbohydrates and fats. These hormones include *corticosterone, cortisol,* and *cortisone.* The glucocorticoids are secreted by the *cortex* (outer part) of each adrenal gland. Insulin and *growth hormone* (GH), a hormone secreted by the *anterior lobe* (front part) of the pituitary gland, also regulate the creation of new tissue.

GH also controls the use of food in other ways. For example, it stimulates cells to use fat, rather than sugar, as an energy source, and so helps maintain a fairly high level of sugar in the blood. Such a level is necessary for the brain to function properly.

Growth and sex hormones. The body's development from infancy to adulthood involves a complex process of physical changes. Hormones play a key role in regulating these changes.

GH controls overall growth during childhood. Faulty production of this hormone during childhood can cause a person to become a dwarf or a giant. In adults, GH enables certain tissues to maintain their proper size and structure. Insulin, glucocorticoids, and thyroxine also play major roles in tissue growth and maintenance.

Beginning at the age of about 11 to 15, young people go through a period of rapid growth and physical change. Hormones control the development that occurs during this period, called *puberty.* At the start of puberty, the *hypothalamus,* the portion of the brain nearest the pituitary gland, greatly increases its secretion of *gonadotropin-releasing hormone.* This hormone acts on the anterior lobe of the pituitary. It stimulates the gland to secrete the *gonadotropic hormones—follicle-stimulating hormone* (FSH) and *luteinizing hormone* (LH). These hormones, in turn, act on the *gonads* (sex glands)—the testicles in males and the ovaries in females.

Under the influence of FSH and LH, the gonads grow and begin to secrete large amounts of *sex hormones.* The male sex hormones, including *testosterone* and *androsterone,* are called *androgens.* The female sex hormones include *progesterone* and the *estrogens.* The most important estrogens are *estradiol, estriol,* and *estrone.* The cortex of adrenal glands in both men and women also secretes some sex hormones, especially androgens.

The sex hormones regulate the remarkable changes that occur during puberty. They help trigger a person's rapid growth in height and weight and, at the end of puberty, they stop this growth. Androgens cause the male sex organs to mature, and they stimulate male sexual behavior. Androgens also stimulate the development of such secondary male characteristics as a deep voice and a beard. Estrogens cause the female sex organs to develop fully, and they establish female sexual behavior. They also stimulate the development of secondary female characteristics, such as full breasts and wide hips. In a woman's body, FSH, LH, estrogens, and progesterone work together to control the menstrual cycle (see **Menstruation**). Progesterone also regulates processes necessary for pregnancy.

Blood composition hormones. Healthy blood contains fairly exact levels of several chemical substances. If the level of these chemicals becomes too high or too low, the body can be harmed.

A number of hormones work together to ensure that the composition of the blood remains within normal ranges. *Parathormone,* secreted by the parathyroid glands, and *calcitonin,* from the thyroid, regulate the level of calcium in the blood. Parathormone also controls the amount of phosphate. The *mineralocorticoids,* a group of hormones secreted by the adrenal cortex, control the balance between salts and water in the blood. *Aldosterone* is the most important mineralocorticoid. *Vasopressin,* also called *antidiuretic hormone,* regulates the water level of the blood. It is produced by the hypothalamus, but it is stored in and released by the *posterior lobe* (rear part) of the pituitary.

Stress hormones are secreted in case of anger, fright, or injury. The *medulla* (inner portion) of the adrenal glands secretes *epinephrine* and *norepinephrine,* also known as *adrenalin* and *noradrenalin.* These substances prepare the body for stress. For example, epinephrine increases the pulse and speeds the conversion of food to energy in the muscles. The glucocorticoids also help the body adjust to stress.

Endocrine control hormones affect the production of other hormones. They include FSH and LH, the anterior pituitary hormones that regulate the secretions of the gonads. The anterior pituitary also secretes *thyroid-stimulating hormone* (TSH) and *adrenocorticotropic hormone* (ACTH). TSH stimulates the thyroid to secrete thyroxine. ACTH stimulates the adrenal cortex, causing increased secretions of glucocorticoids, mineralocorticoids, and adrenal sex hormones.

The anterior pituitary itself is regulated by hormones released by the hypothalamus. These substances are called *releasing hormones.* The gonadotropin-releasing hormone triggers the secretion of FSH and LH. Other releasing hormones stimulate the pituitary's production of ACTH, GH, and TSH. *Prolactin,* another hormone of the anterior pituitary, is also controlled by a hypothalamic hormone. One of the effects of prolactin is the stimulation of milk production in nursing mothers.

The hypothalamus, which forms part of the brain, consists of nerve tissue. Thus, the releasing hormones link the body's nervous and endocrine systems into one coordinated control unit. The sense organs gather information on changes in the environment, which they relay to the brain through the nervous system. If these changes call for a hormonal response, the hypothalamus triggers the appropriate pituitary secretions.

Other hormones in human beings include *oxytocin* and *relaxin,* both of which affect the process of birth. Oxytocin, like vasopressin, is produced by the hypothalamus and is stored in and secreted by the posterior pituitary. The ovaries produce relaxin. Relaxin widens the birth canal, the passageway through which a baby leaves its mother's body. Oxytocin causes the muscles of the uterus to contract during labor. Oxytocin also stimulates the release of milk from the mother's breasts when the infant nurses.

Melanocyte-stimulating hormone (MSH) is a hormone secreted by the anterior lobe of the pituitary. Among certain amphibians, fish, and reptiles, MSH regulates

the amount of *pigment* (coloring matter) in the skin. Its function in the human body is not yet understood.

Hormones of other animals

Other vertebrates, especially other mammals, have most of the same hormones people have. Many of these chemicals are nearly identical in structure and effect to human hormones. This similarity enables scientists to learn about human hormones by studying those of other vertebrates. In some cases, doctors can use hormones secreted by animals to treat patients whose bodies do not produce sufficient amounts of certain hormones.

Invertebrates also produce hormones, some of which play an important role in growth and development. For example, hormones control the changes through which such insects as bees and butterflies pass while growing.

Plant hormones

Plant hormones are produced mainly in actively growing parts, such as the tips of roots and stems. These hormones influence growth and are often called *growth regulators*. There are three main types of plant hormones: (1) *auxins,* (2) *cytokinins,* and (3) *gibberellins*.

Auxins cause various effects on different parts of a plant. In stems and roots, auxins regulate the *elongation* (lengthening) of cells. By stimulating cell elongation, auxins affect the manner in which stems bend toward light and away from gravity. Auxins also control the process by which roots bend toward gravity, but they do so by preventing the elongation of cells.

In many plants, auxins secreted by the bud at the tip of a stem prevent lower buds on the stem from growing. Thus, they slow the growth of side branches. Such branches could use up energy a plant needs to grow tall and sturdy. Auxins also stimulate the growth of fruit and prevent fruit and leaves from falling off a plant.

Cytokinins control cell division in plants. They apparently work together with other growth regulators, especially auxins. Cytokinins play an important role in determining which cells of a young plant will become root cells, which cells will become leaf cells, and so on.

Gibberellins stimulate many plants to grow larger. When used in experiments, they have made the stems of dwarf plants lengthen rapidly. Gibberellins also help regulate blossoming in certain plants. They cause the seeds and buds of many species to begin growing after *dormancy* (long periods of inactivity).

Other growth regulators include *abscisic acid* and *ethylene*. Abscisic acid blocks plant growth, thus stimulating dormancy. Ethylene regulates, among other things, the ripening of fruit.

How hormones work

Most human hormones can be divided into two groups according to their chemical structure. One group, called *steroids,* consists of the sex hormones and the hormones of the adrenal cortex. Most other human hormones contain some form of *amino acids,* the building blocks of proteins.

Both steroids and amino acid hormones work by combining with specialized molecules called *receptors* in the cells of target tissues. Union of a hormone with its receptor triggers chemical changes that affect many cell processes and activities. Scientists think that steroids attach to receptors inside cells, then move into the cell's nucleus. Within the nucleus, steroids affect the activity of *genes,* tiny chemical structures that carry hereditary information. Amino acid hormones appear to attach to receptors on the cell's *membrane* (outer surface). In some cases, attachment of a hormone to the membrane affects which substances can enter or leave the cell. In other cases, binding of a hormone activates additional chemicals called *enzymes* that affect the cell's activities.

Synthetic hormones

Since the 1940's, biochemists have learned to *synthesize* (create artificially) many hormones in the laboratory. Until that time, almost all hormones had to be extracted from animals or plants. Only tiny quantities of hormones occur in living tissue. Synthesis has greatly increased the availability of hormones for human use.

Some synthetic hormones, including synthetic human hormones, are exact duplicates of the natural secretions. But scientists have altered the chemical structure of many synthetic hormones to provide more powerful action. The most common synthetic hormones include auxins; glucocorticoids, particularly cortisone; sex hormones; growth hormone; and insulin. Not all hormones can be synthesized. Scientists do not know the exact chemical structure of some. The structure of other hormones is too complex for practical large-scale synthesis.

Uses of hormones

Medical uses. Physicians use hormones to treat people with *hormone deficiencies*. The body of a patient with such a condition cannot produce an adequate supply of one or more hormones. Hormone therapy enables a person to overcome many of the symptoms of various diseases. Such therapy cannot cure these diseases. It merely controls them. Hormone deficiency diseases include Addison's disease, diabetes mellitus, diabetes insipidus, and myxedema. See **Addison's disease; Diabetes; Thyroid gland** (Underactive thyroid).

Certain other conditions, which are not directly related to hormone deficiencies, may also be treated with hormones. These conditions include arthritis and asthma, for which many physicians prescribe cortisone.

In addition, hormones may be given to alter a function of the body in some way. Birth control pills, for example, contain synthetic female sex hormones. By taking these hormones, a woman alters the endocrine balance that controls the menstrual cycle. This alteration blocks *ovulation* (the release of eggs), thus making it almost impossible for pregnancy to occur.

Agricultural uses. Farmers use synthetic plant hormones, especially auxins, to achieve a variety of results in crop production. When treated with auxins, certain plants—including cucumbers and tomatoes—produce seedless fruit. Farmers also use auxin sprays on apples to prevent the fruit from falling off the tree before harvest. In addition, auxins serve as weedkillers. When sprayed in large concentrations, auxins cause broadleaf weeds to grow in an uncontrolled manner so they die.

Much research has been done on the use of hormones in livestock production. In the United States, certain synthetic estrogens are used to stimulate the fattening of cattle. In 1979, the Food and Drug Administration

(FDA), an agency of the federal government, took steps to ban the use of one such growth stimulant. This hormone, known as *diethylstilbestrol* or *DES,* had been linked to the development of cancer in human beings. Traces of DES had been found in the meat of slaughtered animals (see DES). In 1993, the FDA approved the commercial use of synthetic bovine somatotropin (BST). This hormone has been shown to increase the amount of milk produced by dairy cows. B. E. Frye

Related articles in *World Book* include:

ACTH	Epinephrine	Ovary
Adrenal gland	Estrogen	Pancreas
Auxin	Giant	Parathyroid gland
Biochemistry	Gibberellin	Pituitary gland
Cortisone	Goiter	Progesterone
Disease (Metabolic diseases)	Growth	Prostaglandin
	Hormone replacement therapy	Steroid
Drug (Hormones; Animals)		Testicle
	Hypothalamus	Testosterone
Dwarf	Insulin	Thyroid gland

Additional resources

Little, Marjorie. *The Endocrine System.* Chelsea Hse., 1990. Younger readers.

Vines, Gail. *Raging Hormones: Do They Rule Our Lives?* Univ. of Calif. Pr., 1994.

Young, John K. *Hormones: Molecular Messengers.* Watts, 1994.

Hormone replacement therapy restores a woman's supply of the sex hormones estrogen and progesterone after her ovaries stop producing them. Production of these hormones declines as women age, then stops at *menopause,* the time that menstruation ends.

Falling estrogen levels may cause symptoms as women approach menopause. For example, many women experience sudden episodes of intense heat and sweating known as *hot flashes* and *night sweats.* These attacks may cause discomfort or disrupt sleep. Declining estrogen may also cause dryness and irritation of the vagina.

Hormone replacement therapy (HRT) relieves symptoms of menopause by restoring the body's supply of estrogen. However, taking estrogen by itself increases the risk that a woman will develop cancer of the *uterus,* the organ in which a baby develops. To reduce this risk, doctors prescribe estrogen with progesterone for women who have a uterus. If a woman's uterus has been removed, doctors may prescribe estrogen alone.

Long-term hormone therapy may prevent several diseases common in older women. For example, estrogen may prevent heart disease and *osteoporosis,* a loss of bone tissue that makes bones likely to break.

To relieve symptoms of menopause, HRT is usually needed for only a few years. The therapy may be risky for women with certain conditions, such as breast cancer, blood clots, or liver disease. Doctors are not sure that long-term therapy is effective or safe. Some studies show that extended use of hormones may slightly increase a woman's risk of developing breast cancer and may actually increase, rather than reduce, the risk of heart disease.

In the United States, the National Institutes of Health is investigating how long-term HRT affects the risk of breast cancer in a study called the Women's Health Initiative. This study will also try to determine when hormone therapy should begin, how long it should last, and how effectively it prevents heart disease. An additional goal is to learn if HRT reduces risk of Alzheimer's disease, a brain disorder common in older adults.

Researchers are also working to create synthetic hormones that act like estrogen in some tissues but block estrogen's effects in others. These hormones are called *selective estrogen receptor modulators* (SERM's). SERM's may offer an alternative to HRT for some women. Raloxifene, one of the first such hormones developed, works like estrogen to reduce loss of bone and lower cholesterol levels. Unlike estrogen, it does not stimulate tissues in the breast and uterus, and it does not prevent hot flashes. Susan R. Johnson

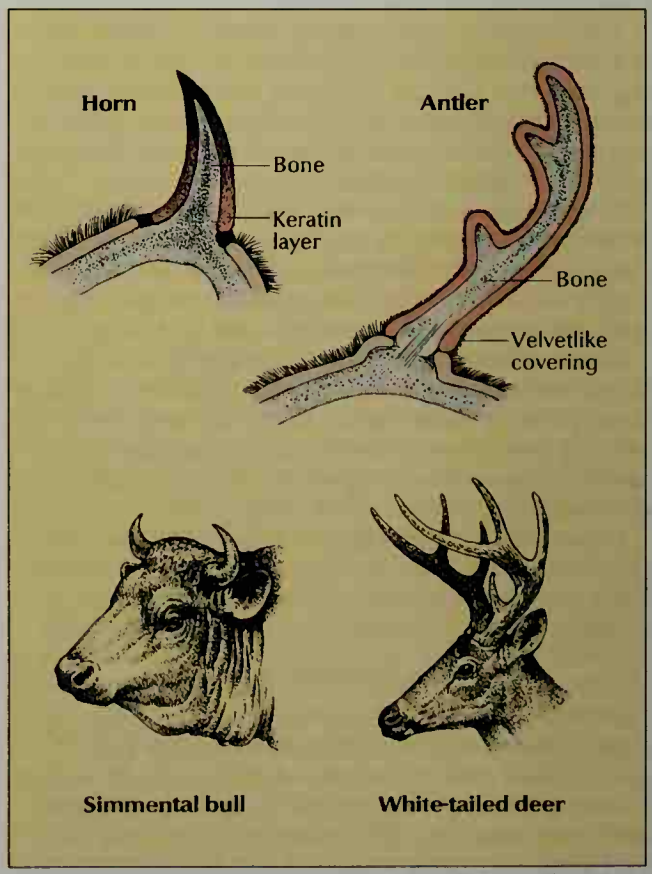
See also Estrogen; Menopause; Progesterone.

Horn is a pointed, bony structure on the heads of many mammals. Most horned animals have a pair of horns. Such animals as cattle, sheep, goats, and antelope have true horns. Deer have hornlike growths that are not true horns. These growths are called *antlers.*

Horns have a bony core. The core is an extension of one of the skull bones. A layer of skin covers the core. This skin contains a protein called *keratin* that makes the horn extremely tough and durable. See **Keratin.**

Among many horned animals, both the male and the female grow horns. The horns may be elaborately curved, but—except in the pronghorn—they do not form branches as do antlers. Horned animals keep their horns for life. The pronghorn sheds the coverings of its horns and grows new coverings each year.

Among most antlered animals, only the male grows antlers. The animal sheds its antlers every year. Like



WORLD BOOK illustrations by John D. Dawson

Horns and antlers differ in structure. Horns are permanently covered by hard, keratin-rich skin. Antlers have a velvetlike covering that the animal eventually rubs off. This illustration shows cross sections of a bull's horn and a deer's antler.

horns, antlers grow out of bones in the skull. At first, antlers have a velvetlike covering of skin over the bone. But instead of becoming hard, this covering dies and is rubbed off by the animal. See **Deer** (Antlers; picture: How a deer's antlers grow); **Moose** (picture).

Horns and antlers have a number of functions. They serve as weapons to protect the animals from attack. Male animals sometimes use their horns or antlers to fight other males in the group. Such fighting establishes which male is the most important. More often, a male avoids a fight and establishes his superiority through gestures that may include displaying and threatening to use his horns or antlers. Lawrence C. Wit

See also **Animal** (How animals protect themselves [picture]).

Horn is the general name for musical instruments of the brass family. The most popular horns include the bugle, cornet, flügelhorn, French horn, trombone, trumpet, and tuba. The term *horn* is often used to refer only to the French horn.

Most horns are made of brass and consist largely of tubing in various shapes and lengths. The differences in tubing produce a variety of tone colors, from the brilliant sound of the trumpet to the warm, mellow sound of the French horn. The pitches of all horns are determined by the tension of the player's lips in the horn's mouthpiece and by the use of valves or slides.

The earliest horns were made from natural materials, such as animal horns, tusks, shells, or hollow lengths of wood. People originally used horns to send signals over distances too great to be covered by the human voice. As sophisticated instruments developed, various types of horns became popular in military bands and orchestras. However, in many parts of the world, primitive horns made of natural materials are used today for signaling or to accompany dances or ceremonies. The oldest horn in continual use is the ancient Hebrew *shofar,* made from a curved ram's horn. This instrument dates back about 6,000 years and is still used in Jewish religious services. Stewart L. Ross

Related articles in *World Book* include:

Alphorn	Flügelhorn	Music (Wind instruments)	Trumpet
Bugle	French horn		Tuba
Cornet		Trombone	

Horn of plenty. See **Cornucopia.**

Hornbeam. See **Ironwood.**

Hornbill is the name of over 40 species of medium-sized to large birds with huge, often colorful, bills. Hornbills are found in tropical Africa and Asia. They eat fruit, insects, reptiles, and small mammals. Hornbills use their clumsy-looking bills with great skill when eating. For example, the bird holds poisonous snakes at the tip of the bill, away from the face, and rolls the snake back and forth through the tip until it is crushed.

Hornbills have unusual nesting habits. In all but two species, the female lays one to five eggs within a cavity in a hollow tree. The female then imprisons herself and her eggs inside the nest chamber by blocking the entrance hole with a cementlike wall built from her droppings. The male passes food to the female through a narrow slit in the wall. In some species, the female remains walled in the nest for over 100 days until she and her grown young burst free. Hornbill nests are relatively safe from most predators. David M. Niles

Scientific classification. Hornbills make up the hornbill family, Bucerotidae.

See also **Bird** (picture: Birds of Europe and Asia).

Hornblende is any of a group of fairly hard rock-forming minerals. It is the most common type of *amphibole.* An amphibole is a *silicate,* a mineral composed chiefly of silicon and oxygen that is found throughout the earth's crust. Hornblendes occur in many *igneous* and *metamorphic* rocks (see **Rock**).

Hornblendes range in color from dark green to dark brown or black. Most hornblendes occur as shiny crystals that are shaped like a prism. But some are small, irregularly shaped grains.

All hornblendes contain aluminum, calcium, iron, and magnesium in addition to silicon and oxygen. Many also have potassium, sodium, and titanium. Hornblendes vary widely in chemical composition. For example, one variety called *hastingsite* is rich in sodium and iron. Another known as *tschermakite* has much aluminum.

Mary Emma Wagner

Hornbook. Paper was scarce and expensive during the Middle Ages and until the early 1800's. It had to be used sparingly. The hornbook was invented to protect the paper on which the first lessons of young children were printed. It was used as early as 1442. By the end of the 1500's, the hornbook was standard equipment in English schools. Use of the hornbook continued in England and America until about 1800, when books became cheaper. Today, hornbooks are rare collector's items.

Granger Collection

Hornbook

The hornbook was a flat board with a handle. On the board was pasted a sheet of paper with the simple lesson of the beginning student. On the paper were usually the alphabet, the Benediction, the Lord's Prayer, and the Roman numerals. The alphabet often was given, with the vowels heading the list, followed by combinations of vowels and consonants, such as *ab, eb, ib, ob,* and *ub.* The whole board was covered with a thin, flat piece of clear horn, through which a person could read the paper. The flattened horn was made transparent by boiling and scraping.

The handles of many hornbooks had holes so that the hornbooks could be worn around the neck or fastened to a belt. In some wealthy English families, the backs of the boards were of leather ornamented with pictures or designs inlaid with silver or gold filigree. American settlers had simpler hornbooks.

In the 1700's, gingerbread "hornbooks" were often made. Students were allowed to eat a letter of the alphabet that they had learned. Hornbooks were used only in England and America. Gerald L. Gutek

Horne, Lena (1917-), is an American singer and actress. She became famous for her beauty and as a popular singer of the blues. She developed a distinctive vocal style that ranged from a growl to a soft croon.

Horne was born in New York City. At the age of 16,

she became a chorus dancer at the Cotton Club in Harlem. In 1942, Horne became the first black performer to sign a long-term contract with a major Hollywood film studio. She gained attention with her rendition of the song "Stormy Weather" from the 1943 movie of the same name.

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Lena Horne

After the end of World War II in 1945, Horne became a major nightclub attraction in the United States and Europe. She made a number of movie musicals in the 1940's and 1950's and starred in the Broadway musical *Jamaica* (1957). She also wrote an autobiography, *Lena* (1963). In 1983, Horne received the Spingarn Medal in recognition of her achievements. Rachel Gallagher

Horne, Marilyn (1934-), is an American opera star known for her wide vocal range and technical agility. At the beginning of her long career, she sang soprano as well as mezzo-soprano roles. Horne became famous for her performances in operas composed in the Italian *bel canto* style, which emphasizes beautiful tones and technical skill. She has sung roles in operas written by such composers as the Italians Vincenzo Bellini, Gaetano Donizetti, and Gioacchino Rossini.

Horne was born in Bradford, Pennsylvania, on Jan. 16, 1934. She made her operatic debut in 1954 with the Los Angeles Guild Opera in *The Bartered Bride*. Horne first sang with the Metropolitan Opera in 1970 in *Norma*.

Martin Bernheimer

Horned lizard is the name of 14 species of North American lizards. They are often called *horned toads* or *horny toads* because their body has a flattened, toadlike shape. Horned lizards grow 2 $\frac{1}{2}$ to 6 $\frac{1}{2}$ inches (6.4 to 16.5 centimeters) long. Their bodies are covered with sharp spines. Large hornlike spines project from the back of their head. Their spiny armor protects them from attacking animals. When attacked, horned lizards sometimes squirt little streams of blood from their eyes. This ability may help them ward off such enemies as coyotes.

Horned lizards live in deserts and other dry regions of the United States, Canada, and Mexico. Their colors resemble the colors of their surroundings and make them hard to find. These lizards move slowly and feed chiefly on insects, especially ants. Most species lay eggs. In a few species, the young are born living. Raymond B. Huey

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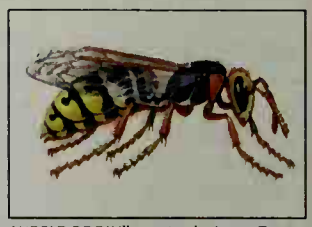
A horned lizard has sharp spines on its head and its back. It feeds on ants and other insects.

Scientific classification. Horned lizards belong to the New World lizard family, Iguanidae. All species are members of the genus *Phrynosoma*.

See also **Lizard** (Defenses).

Hornet is the name of any one of several large social wasps. One of the most common hornets in North America is the *baldfaced hornet*. Its stout, black body is covered with white markings, and it has a white face. The nest of the baldfaced hornet is found hanging in shrubs and trees and occasionally on buildings. By late summer, it may be larger than a basketball and contain hundreds of adult hornets.



WORLD BOOK illustration by James Teason

Giant hornet

Hornets were the first papermakers. They make large paper nests from chewed up wood and plant fiber. A mated female called the *queen* starts to make the nest in the spring. She constructs several hexagonal cells, lays a few eggs, and feeds the larvae. All the young of this first brood are females. They become *workers* who help the queen enlarge the nest, gather food, and rear additional broods. Hornets use their nest for only one season. In the fall, new queens and males are born. After mating, the queens leave the nest to hibernate in a protected location. The workers and males die after the first frosts.

Hornets are nervous insects that will readily sting if disturbed. Stinging injects a *venom* (poison) that causes a painful swelling that may last for some time. Nevertheless, hornets are helpful insects. Workers capture flies, caterpillars, and other pests for the queen's young.

A species called the *giant hornet* is common along the east coast of the United States. It often flies during the evening and is sometimes attracted to porch lights. It was introduced from Europe into the United States during the mid-1800's. It nests mainly in hollow trees.

Robert W. Matthews

Scientific classification. Hornets are members of the family Vespidae. The baldfaced hornet is *Dolichovespula maculata*. The giant hornet is *Vespa crabro*.

See also **Insect** (picture: Familiar kinds of insects); **Wasp**; **Yellow jacket**.

Horney, *HAWR ny,* **Karen** (1885-1952), was a German-born physician and psychoanalyst. She became known chiefly for challenging the Austrian psychoanalyst Sigmund Freud over the stress he put on biology in explaining human psychology. Horney believed that people often behave as they do for social reasons.

Horney criticized Freud's views on the psychology of women. Freud said that women feel inferior to men because of their anatomy and its effect on their psychological development. Horney agreed that many women do feel that way—but not because of biology. She argued that society teaches women to feel inferior.

Horney was born on Sept. 16, 1885, in Hamburg. She

married Oscar Horney, a Berlin attorney, in 1909. She received her M.D. degree from the University of Berlin in 1912. In 1932, Horney moved to the United States. She helped form the American Institute for Psychoanalysis in 1941 and served as its dean until her death on Dec. 4, 1952. Her works include *New Ways in Psychoanalysis* (1939) and *Our Inner Conflicts* (1945). Hannah S. Decker

Hornsby, *HAWRNZ bee,* **Rogers** (1896-1963), an American baseball player, is often called the greatest right-handed hitter of all time. Nicknamed *Rajah,* he won seven National League batting titles and had a .358 lifetime batting average. Only Ty Cobb, with a .367, had a higher average. Hornsby batted .424 in 1924, a single-season record. A second baseman, Hornsby played for the St. Louis Cardinals from 1915 through 1926 and again in 1933; the New York Giants in 1927; the Boston Braves in 1928; the Chicago Cubs from 1929 through 1932; and the St. Louis Browns from 1933 through 1937. He also managed the Cardinals, Braves, Cubs, Browns, and Cincinnati Reds. Hornsby was born on April 27, 1896, in Winters, Texas. He was elected to the National Baseball Hall of Fame in 1942. Dave Nightingale

Hornwort is the name of a group of small, nonflowering plants related to mosses and liverworts. There are over 300 species of hornworts. They are found throughout the world, but are especially common in tropical regions and in warm, moist climates. Hornworts grow mainly on bare, damp, shaded soil. They are often found along roadsides or near edges of streams or lakes.

A hornwort reproduces in a cycle called *alternation of generations.* It has two distinct forms during its life cycle, the *gametophyte* and the *sporophyte.* The gametophyte is made up of a simple plant body called the *thallus.* The thallus looks like a mound of ruffled, dark-green leaflets. It grows along the ground and is usually $\frac{3}{8}$ to $\frac{3}{4}$ inch (1 to 2 centimeters) across. The thallus is anchored to the soil by rootlike structures called *rhizoids.* The sporophyte is long and slender. It may be from $\frac{3}{16}$ to $4\frac{3}{4}$ inches (0.5 to 12 centimeters) high. The sporophyte grows upward from the thallus and resembles cattle horns, giving the plant its name. David H. Wagner

Scientific classification. Hornworts make up the class Anthocerotae in the division Bryophyta.

See also **Liverwort; Moss.**

Horoscope is a chart that supposedly reveals a person's character or future. The chart shows the position of the earth, planets, and stars at a certain time, such as the time of a person's birth. *Astrologers* (people who tell fortunes by studying the stars) believe that the position of these bodies influences a person's life. An astrologer *casts* (draws) a person's horoscope and explains its supposed meaning. Most scientists would say that there is no scientific basis for a belief in horoscopes. Yet, many people believe in horoscopes and base important decisions on advice they receive from astrologers. Others find it amusing just to read general advice published in newspaper "horoscope" columns.

Parts of a horoscope. A horoscope has three main parts that represent three supposed influences on a person's life. The three parts are (1) the zodiac, (2) the houses, and (3) the planets.

The zodiac is a band of stars that appears to encircle the earth (see **Zodiac**). The zodiac consists of 12 divisions called *signs.* Astrologers believe that a person comes under the special influence of a particular sign, depending on the date of the person's birth. For example, a person born from July 23 to August 23 has Leo as a zodiac sign and is often called "a Leo." Each zodiac sign has certain characteristics. For example, a Leo supposedly displays cheerfulness and pride.

The houses represent imaginary divisions of the surface of the earth. Astrologers believe there are 12 houses, which are represented by 12 divisions of a person's horoscope. Each house supposedly influences a certain part of a person's life. The first house, for example, is associated with an individual's appearance and personality. Other houses affect a person's career, health, marriage, or some other interest.

The planets, according to astrologers, include the moon and sun as well as Jupiter, Mars, Mercury, Neptune, Pluto, Saturn, Uranus, and Venus. The planets supposedly have an important influence on the houses and signs. A particular planet *rules* (most influences) each sign. This planet has certain characteristics that affect the sign it rules. For example, Mercury, which is associated with talkativeness and wittiness, rules Gemini. Therefore, people born under the sign of Gemini are supposedly talkative and witty.

Astrologers also believe that the planets influence the activities or interests associated with individual houses. For example, if Venus (associated with beauty) were located in the first house (associated with appearance), an astrologer would conclude that the person had an attractive appearance. The various planets in a person's chart lie at particular angles to one another. These angles, called *aspects,* also have meaning. Astrologers believe certain angles represent signs of good fortune. Other angles supposedly reveal approaching evil.

Explaining a horoscope. A horoscope enables an astrologer to develop several kinds of character readings. Some horoscopes, for example, give only a general idea of a person's character or future. Most horoscopes published in newspapers are of this type. They make predictions based only on the characteristics of zodiac signs. Such a horoscope might tell people born under the sign of Taurus simply that they face an important test in their career. Astrologers may also cast a complete horoscope and study the complicated relationships formed by the houses, planets, and zodiac signs.

Christopher McIntosh

See also **Astrology; House** (astrology); and the articles on signs of the zodiac, such as **Aries.**

Horowitz, *HAWR uh wihts,* **Vladimir,** *VLAD ih MEER* (1904?-1989), a Russian-born pianist, was one of the world's greatest musicians. He won fame for his magnificent technique, which combined outstanding power and attention to detail. His performances featured the works of composers of the 1800's and 1900's. Horowitz also made a number of recordings.

Horowitz was born on Oct. 1, 1903 or 1904, in Kiev, Ukraine (then part of the Russian Empire), and received his early training there. In 1925, he began to play in leading European cities with the most famous conductors. Horowitz first performed in the United States in 1928. He settled in the United States in 1940 and became a U.S. citizen in 1944. Beginning in 1965, he gave a number of recitals, which were highly praised by critics. He died on Nov. 5, 1989. F. E. Kirby

Hans Reinhard, Bruce Coleman Ltd.

The beauty of horses contributes to their great popularity. The powerful bodies and flowing manes and tails of the Arabian horses shown above give the animals a noble appearance.

Horse

Horse has been one of the most useful animals for thousands of years. Horses once provided the fastest and surest way to travel on land. Hunters on horseback chased animals and killed them for food or for sport. Soldiers charged into battle on sturdy war horses. The pioneers used horses when they settled the American West in the days of stagecoaches, covered wagons, and the pony express.

The horse is not as important as a means of transportation as it once was. In most countries, the *iron horse* (train) and *horseless carriage* (automobile) have replaced the horse almost entirely. But people still use horses for recreation, sport, and work. Children and adults ride horses for fun and exercise. Large crowds thrill to the excitement of horse races. Horses perform in circuses, rodeos, carnivals, parades, and horse shows. They help ranchers round up great herds of cattle, and they may be used to pull plows and do other farm work.

The horse is well suited for working and running. For example, its wide nostrils help it breathe easily. Horses have a good sense of smell, sharp ears, and keen eyes. They have strong teeth, but they eat only grain and plants, never meat. Long, muscular legs give horses the strength to pull heavy loads or to run at fast speeds. Horses also use their legs as their chief weapons. The kick of a horse can seriously injure a human being or an animal.

Horses are eager to please their owners or trainers. Most horses have good memories and can easily be trained to obey commands. A horse may learn to come when its owner whistles. A circus horse takes "bows" when its trainer touches its front legs with a whip. Horses can learn to respond to even the slightest signals. People who watch an expert rider on a well-trained horse often cannot see these signs. For example, the horse moves forward when the rider's legs are pressed lightly against the horse's side. It turns at a touch of the reins against its neck. The quick obedience of the horse has helped make it one of our most valuable animals.

People have improved the natural qualities of the horse by breeding various kinds of horses. For example, horse raisers can breed a fast horse with a strong horse to produce an animal that has both speed and power.

Stephen Duren, the contributor of this article, is Equine Nutritionist at Kentucky Equine Research. He is the author of The Concise Guide to Nutrition in the Horse.

There are more than 150 breeds and types of horses and ponies. The breeds vary greatly in size, strength, speed, and other characteristics. One of the smallest breeds is the Falabella, which grows only 30 inches (76 centimeters) high. Falabellas were originally bred in Argentina and are kept as pets. The largest breed of horse is the shire, which was originally developed in England. Shires may grow over 68 inches (173 centimeters) high. They may weigh over 2,000 pounds (910 kilograms).

Shires and other large breeds, such as the Belgian, Clydesdale, and Percheron, are the strongest horses. They can pull loads that weigh more than a short ton (0.9 metric ton). The two fastest breeds are the quarter horse and the thoroughbred, which are often bred and trained for racing. The quarter horse can run $\frac{1}{4}$ mile (0.4 kilometer) in about 20 seconds. But the thoroughbred can run longer distances faster. It can cover a mile (1.6 kilometers) in about 1 $\frac{1}{2}$ minutes.

The various breeds of horses are commonly divided into three main groups: (1) light horses, (2) heavy horses, and (3) ponies. Light horses have small bones and thin legs. Most light horses weigh less than 1,300 pounds (590 kilograms). Heavy horses have large bones and thick, sturdy legs. Some weigh more than 2,000 pounds (910 kilograms). Ponies are small horses that stand less than 58 inches (147 centimeters) high when full grown. Most ponies weigh less than 800 pounds (360 kilograms).

Each of the three main groups of horses has many breeds. However, a single breed may include horses of more than one type. For example, certain kinds of Hackneys are classified as light horses, and other kinds are considered ponies. In addition to light horses, heavy horses, and ponies, there are also a few kinds of wild horses.

Horse terms

Bronco, or **Bronc,** is an untamed Western horse.
Colt, technically, is a male horse 4 years old or less. However, the word colt is often used for any young horse.
Crossbred means bred from a sire of one breed and a dam of another.
Dam is the mother of a foal.
Filly is a female horse 4 years old or less.
Foal is either a newborn male or a newborn female horse.
Frog is the elastic, middle part of the sole of a horse's foot.
Gait is any forward movement of the horse, such as the walk, trot, or gallop.
Gelding is a male horse that cannot be used for breeding because it has had some of its reproductive organs removed.
Grade is an unregistered horse or pony of mixed breed.
Hand is a unit used to measure the height of a horse, from the ground to the highest point of the withers. A hand equals 4 inches (10 centimeters).
Mare is a female horse more than 4 years old.
Mustang is the wild horse of the Western plains, descended from Spanish horses.
Pony refers to a horse less than 58 inches (147 centimeters) tall when full grown.
Purebred means bred from horses that are of the same breed.
Sire is the father of a foal.
Stallion is a male horse that can be used for breeding.
Yearling is a horse that is more than 1 and less than 2 years old. In the Northern Hemisphere, a race horse is considered a yearling from the first January 1 after its birth until the following January 1. In countries of the Southern Hemisphere, a race horse's official birthday is either July 1 or August 1.
Withers is the ridge between a horse's shoulder bones.

Some types and breeds of horses

Type or breed	Place of origin	Weight In lbs.	Weight In kg	Height in hands*
Saddle horses				
American saddlebred	United States	900 to 1,200	410 to 540	14.3 to 16.1
American quarter horse	United States	900 to 1,200	410 to 540	14.2 to 15.3
Appaloosa	United States	950 to 1,175	430 to 530	14.2 to 15.2
Arabian	Arabia	850 to 1,000	390 to 450	14.2 to 15.3
Morgan	United States	800 to 1,100	360 to 500	14.2 to 15.2
Palomino	United States	900 to 1,300	410 to 590	14.1 to 16
Tennessee walking horse	United States	900 to 1,200	410 to 540	15 to 16
Thoroughbred	England	1,000 to 1,300	450 to 590	15 to 17
Light harness or roadster horses				
Hackney	England	900 to 1,200	410 to 540	14.3 to 16.2
Standardbred or American trotter	United States	800 to 1,200	360 to 540	15 to 16
Draft horses				
American cream	United States	1,600 to 2,000	730 to 910	15.2 to 16.3
Belgian	Belgium	1,700 to 2,200	770 to 1,000	16 to 19
Clydesdale	Scotland	1,500 to 2,000	680 to 910	16 to 17.1
Percheron	France	1,600 to 2,100	730 to 950	15 to 17
Shire	England	1,800 to 2,300	820 to 1,040	16 to 17
Suffolk	England	1,500 to 1,900	680 to 860	15.2 to 16.2
Heavy harness or coach horses				
Cleveland bay	England	1,250 to 1,550	570 to 700	15.3 to 16.3
French coach	France	1,100 to 1,400	500 to 640	15.1 to 16.3
German coach	Germany	1,200 to 1,500	540 to 680	15.2 to 16.3
Ponies				
Hackney pony	England	600 to 850	270 to 390	12 to 14.2
Pony of the Americas	United States	500 to 900	230 to 410	11.2 to 13.2
Shetland pony	Shetland Islands	300 to 500	140 to 230	9 to 11.2

*One hand equals 4 inches (10 centimeters).

Light horses

Saddle horses for riding make up an important group of breeds. Many people ride horses for pleasure or raise them as a hobby. Some riders achieve great skill and compete with other riders in horse shows and sports involving horses.

The most popular breeds used for pleasure riding in the United States include the American saddlebred, Tennessee walking horse, Morgan, quarter horse, and Arabian. Plantation owners living in the southern U.S. developed the American saddlebred and the Tennessee walking horse. The owners wanted mounts that were comfortable to ride. Tennessee walking horses are especially noted for their comfortable running walk and smooth canter. All Morgan horses can be traced back to a New England stallion named Justin Morgan. Morgans were originally used as harness horses for pulling carriages and for harness racing. After automobiles be-

Fritz Prenzel, Bruce Coleman Inc.

American saddlebred

Tom Clark, Shostal

Tennessee walking horse

Harry Cutting, Animals Animals

Morgan

Elisabeth Weiland, Photo Researchers

Arabian

came popular, breeders developed Morgans into excellent saddle horses.

Cowhands use quarter horses for *cutting* (sorting out) cattle from a herd and for other kinds of ranch work. Quarter horses can start, stop, and turn quickly. They respond instantly to the slightest shift of the cowhand's weight or movement of reins. These sure-footed horses have great endurance. They can scramble up and down

© D.K. Langford

The quarter horse is a popular breed for pleasure riding. It also is used for various types of ranch work. Quarter horses are sure-footed, and they move quickly. They were developed in America during the 1700's.

Alix Coleman

Thoroughbred

Robert Pearcy, Animals Animals

Standardbred

steep mountain trails and ford swift streams.

Quarter horses were developed in America during the early 1700's. Breeders crossed thoroughbreds from England with horses from the Spanish colonies of North America. The new breed could start quickly and run at high speed for short distances. Owners used these horses for the sport of *quarter racing,* a $\frac{1}{4}$ -mile (0.4-kilometer) race along a straight path.

The strong Arabian horse is noted for its endurance. Arabs developed this breed for use in the desert. For hundreds of years, breeders in many countries have brought these horses from Arabia and used them to develop new breeds.

One breed that developed from Arabian horses is the thoroughbred. All thoroughbreds can be traced back to three stallions known as the Darley Arabian, the Godolphin Arabian (sometimes called the Godolphin Barb), and the Byerly Turk. In the late 1600's and early 1700's, European breeders crossed these stallions with their own horses to produce the first thoroughbreds. Thoroughbreds are high-spirited, sensitive horses. They have powerful lungs and strong legs, which makes them especially well suited for racing. They are also used for jumping and hunting. In addition, many polo ponies are part thoroughbred.

Lipizzan horses, or Lipizzaners, come from horses imported into Austria from Spain and Italy during the middle 1500's. These beautiful show horses have strong bones, short legs, and thick, arched necks. Their powerful hindquarters enable them to make difficult jumps. The best-known Lipizzaners are those trained at the Spanish Riding School of Vienna in Austria. These horses perform graceful jumping and dancing feats.

Light harness horses, sometimes called *roadsters,* include the Morgan, the Hackney, and the standardbred. The standardbred, also called the American trotting horse, is considered the best horse for harness racing. Owners train standardbreds to race at either a trot or a pace. Breeders developed the standardbred by crossing thoroughbreds with Morgans and other breeds.

Color types. Light horses are sometimes grouped by color types instead of by breed. Such groups include palominos and albinos. Some people consider Appaloosas a color type, but these horses actually form a breed.

Palominos have a golden coat and a light blond or silvery mane and tail. Most of them have white only on the face and on the legs below the hocks and knees. Palominos belong to almost every breed except the thoroughbred. A palomino mare and stallion often produce a *foal* (baby horse) of another color. Breeders in the United States and Mexico developed the palomino line.

© Bundesgestüt Piber

Lipizzaner

Karen Ann Wilson, Natural Selection

Palomino

Jane Burton, Bruce Coleman Ltd.

Albino

Alan & Sandy Carey, Natural Selection

Appaloosa

Albinos. Some breeders use the word *albino* to describe any horse with a white or pale-colored coat. However, a true albino is an animal that, because of heredity, has no color in its eyes, hair, or skin. Its offspring also lack color.

All albinos have some color that their offspring can inherit. One kind has a pink skin, ivory coat, white mane, and blue eyes. Another has pink skin, a white coat, and brown eyes. Horses that are born black and turn white as they grow older are not usually called albinos.

Appaloosas vary greatly in color. But the vast majority have a white area on the loin and hips with small, round or oval dark spots. Appaloosas are sometimes called *raindrop horses* because of their spots. They also have white-rimmed, humanlike eyes. Black and white stripes cover the hoofs of most Appaloosas.

Spanish adventurers first brought Appaloosas to North America. The Nez Perce Indians of what are now Idaho and Washington bred these horses in the Palouse River region. The name *Appaloosa* comes from the word *Palouse*.

Heavy horses

Draft horses are the tallest, heaviest, and strongest group of horses. They are descended from the war horses that heavily armored knights rode into battle. *Draft* (work) horses once supplied much of the power for jobs that heavy trucks and tractors do today. They pulled plows on farms and hauled freight wagons from town to town. Draft breeds include the shire, Clydesdale, Belgian, Percheron, Suffolk, and American cream.

The shire is the largest horse. This breed developed in England after King Henry VIII had all horses less than 5 feet (1.5 meters) high destroyed as useless.

The Clydesdale, one of the handsomest draft breeds, has long, flowing hair below the knee and the *hock* (joint on the hind legs). This hair, called "feathers," gives the animals a smart and unusual look. Clydesdales are popular horses for pulling wagons in parades.

The Belgian ranks among the gentlest and strongest horses. Heavy muscles give the Belgian a stout appearance, and the head may seem too small for the huge

Sally Ann Thompson, Animal Photography

Clydesdale

Anheuser-Busch, Inc.

Shire

WORLD BOOK photo

Belgian

C. Prescott-Allen, Animals Animals

Suffolk

C. Prescott-Allen, Animals Animals

Percheron

body. Most Belgians have chestnut or bay-colored coats. Percherons look much like Belgians but have gray or black coats. These horses are lively for their size and may be used as a general-purpose horse. The Suffolk, a smaller, chestnut-colored horse, makes an ideal draft horse. The American cream is the only breed of draft horse that originated in the United States. The horse has a cream-colored coat and a white mane and white tail.

Heavy harness horses, which are also called *coach horses,* weigh less than draft horses and are not as strong. These horses are able to do light farm work and make good mounts for pleasure riding. European breeders developed heavy harness horses to pull coaches, wagons, and artillery. Breeds include the Cleveland bay, French coach (Normand), and German coach (Oldenburger).

Cleveland bays look like compact, rugged thoroughbreds. They make excellent general-purpose horses for driving, riding, and hunting. The French coach and German coach breeds were popular in North America until the early 1900's but are seldom seen now.

Ponies

Well-trained ponies make good pets for children. Ponies learn quickly and are usually gentle. They are used for pleasure riding and can pull small carts. Most ponies live longer than other horses. Pony breeds include the Shetland, Welsh, Hackney, Connemara, and pony of the Americas.

A full-grown Shetland pony stands from 32 to 46 inches (81 to 117 centimeters) high. This favorite children's horse once pulled plows and wagons in its native Shetland Islands, which are part of Scotland. Miners in

Robert Pearcy, Animals Animals

Welsh pony

Robert Maier, Animals Animals

Shetland pony

© Robert Maier, Animals Animals

Hackney pony

C. Prescott-Allen, Animals Animals

Przewalski's horse

Wales developed the Welsh pony to work in the cramped tunnels of coal mines. The Hackney is one of the largest pony breeds. The Irish Connemara ponies make good jumpers. The pony of the Americas looks like a miniature Appaloosa. This breed is popular in young people's riding competitions.

Wild horses

Two kinds of wild horses—*Przewalski's horse* and the *tarpan*—probably have the same ancestors that tame horses have. Przewalski's horses are the only true wild horses that exist today. They are considered an endangered species. Tarpans, also called *forest horses,* once lived in parts of Europe, but they became extinct in the late 1800's. See **Przewalski's horse; Tarpan.**

Horses that roam freely in parts of the western United States are often called "wild horses." But they are actually descendants of tame horses that were ridden by Spanish explorers, American Indians, and cowhands of the Old West. The horses escaped from their owners and eventually formed bands. In the early 1900's, more than 2 million of these horses, also called *mustangs,* roamed the West. But people rounded up many of them to clear land for farms and ranches. Many were slaughtered and sold for use in pet food. Today, about 20,000 mustangs roam the West. Federal laws prohibit killing them.

The body of a horse

Size. Horse owners measure the height of a horse in *hands,* from the ground to the highest point of the *withers* (ridge between the shoulder bones). A hand equals 4 inches (10 centimeters), the average width of a man's hand. A horse that stands 14.2 hands (14 hands and 2 inches) is 58 inches (147 centimeters) high.

Coat and skin. The horse's body is covered by a coat of hair. A healthy, glowing coat gives a splendid appearance. A thick winter coat grows every autumn and is shed every spring. Horses never shed the hair of the mane or the tail. If the mane and tail become too thick, the horse's owner may pull out some hair to make the horse look better. Pulling the hair does not hurt because the animal has no nerves at the roots of its hair. A horse uses its tail to brush off insects. A horse also has special

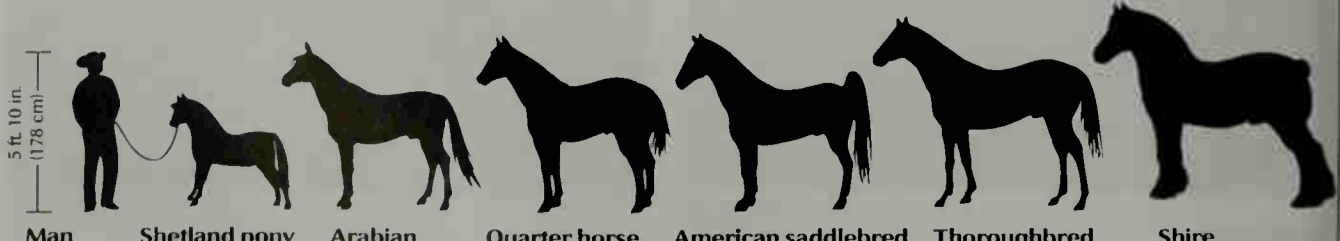
Alan & Sandy Carey, Natural Selection

Pinto

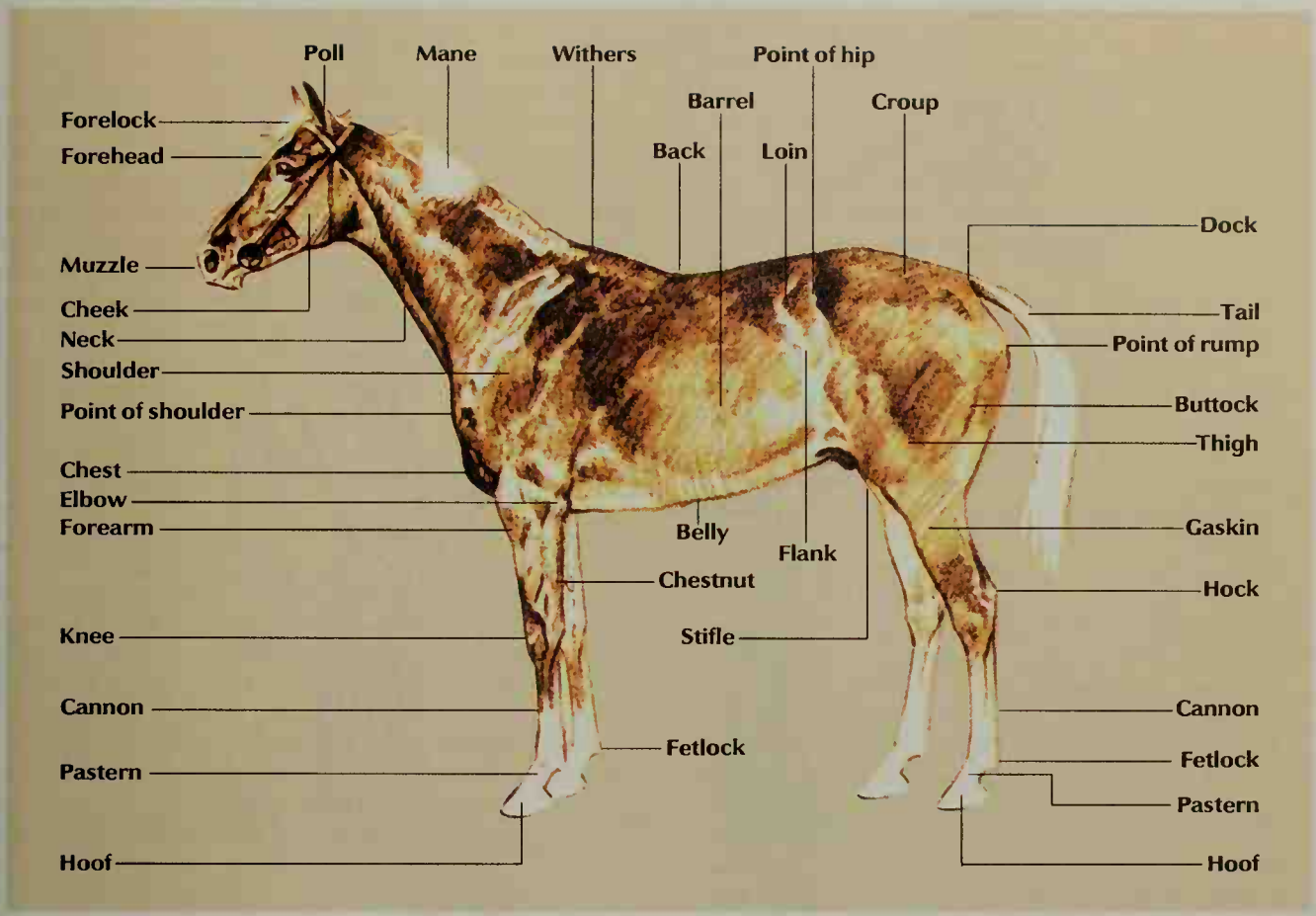
The sizes of horses

Horses range in height from less than 3 feet (0.9 meter) to more than 5 feet (1.5 meters) at the withers. These illustrations show how various breeds compare in height to an average-sized man.

WORLD BOOK illustration



The body of a horse



WORLD BOOK diagram; adapted from a drawing by Paul Brown from *The Horse*, © 1943, used with permission of Charles Scribner's Sons

muscles for twitching the skin to get rid of insects.

Sweat glands on the surface of the horse's body help the animal stay cool. The heavy coats of horses used for fast work, such as racing or polo, should be clipped in winter. The horses can then cool off more easily when they sweat. When the animals are resting, they should be covered with a blanket to keep them warm.

Horses have many colors, including various shades of black, brown, *chestnut* (reddish-brown), *dun* (yellowish-gray), gold, gray, *sorrel* (light reddish-brown), and white. *Bay* horses have a brown coat and black *points* (legs, mane, and tail). Chestnut horses may have *flaxen* (pale-yellow) or sorrel manes and tails, but not black points. Many gray horses are born a dark color and turn lighter as they grow older. Lipizzans and some other gray horses turn white by the time they are fully grown. *Roan* horses have a yellowish-brown or reddish-brown coat sprinkled with gray or white hairs. *Pintos,* also called *paints,* have a black or dark-colored coat with large white areas that vary in pattern.

Special terms are used to describe the markings on a horse's face or legs. These terms include:

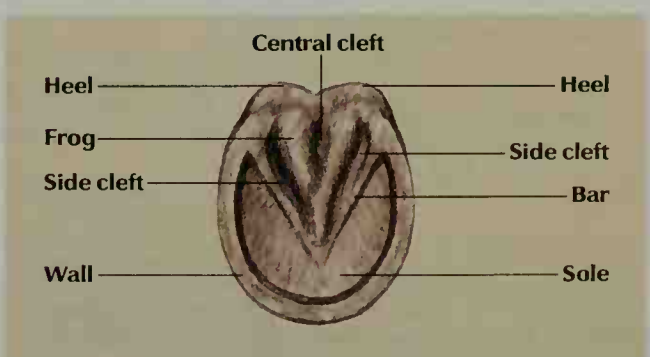
Bald face—a mostly white face.
Blaze—a large white strip on the face.
Race—a narrow strip down the center of the face.
Star—any small white patch on the forehead.
Snip—any small white patch near the muzzle.
Sock—a white patch above the foot.

Legs and hoofs. A horse's legs are suited for fast running. Large muscles in the upper part of the legs provide great speed with a minimum of effort. The long, thin lower legs give the horse a long stride. The front legs carry most of the horse's weight. They absorb the jolts when the animal runs or jumps. The rear legs provide power for running or jumping.

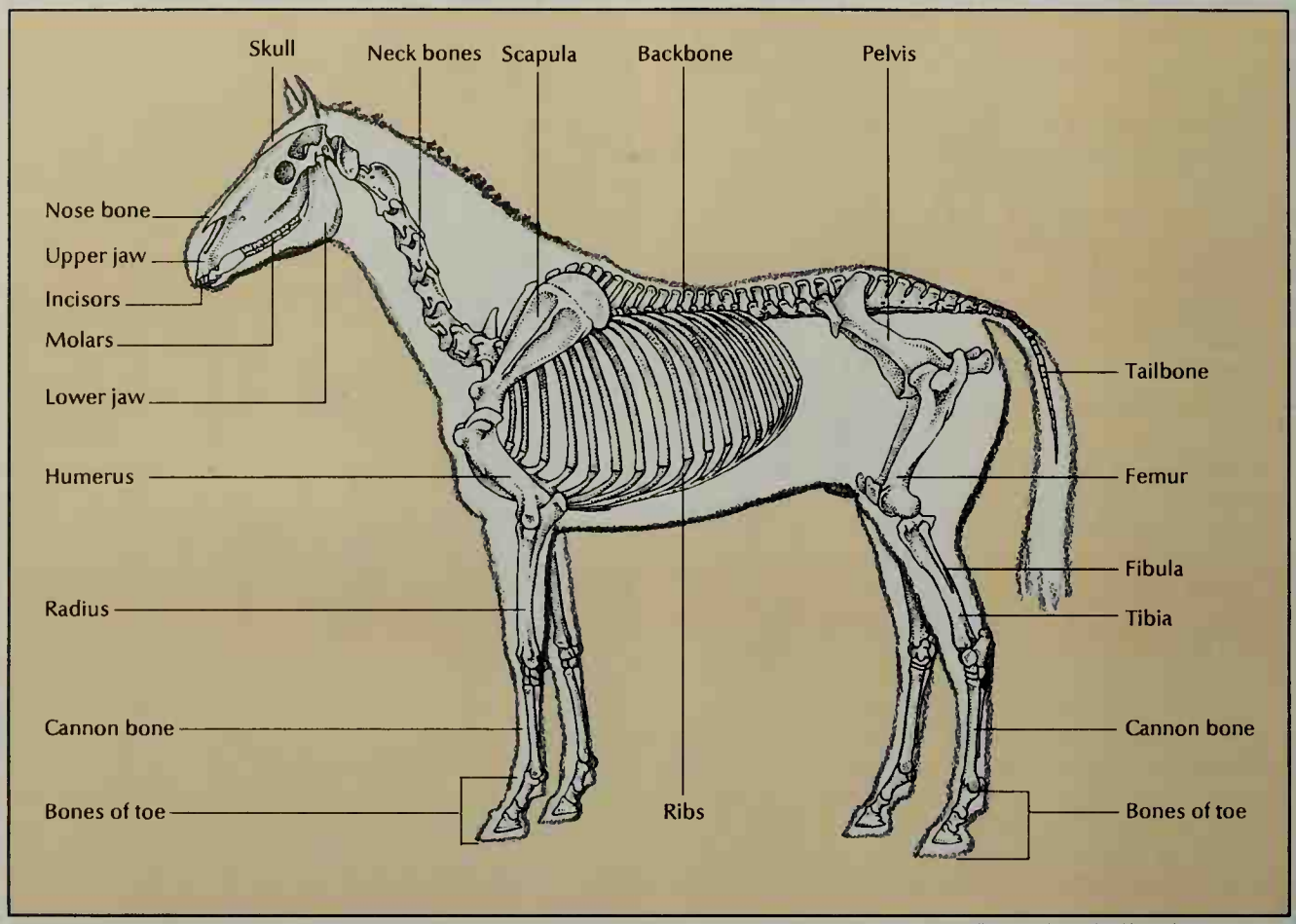
Thousands of years of evolution have given the horse feet ideally suited for running. Each foot is really a strong toe. Only the tip of the toe, protected by the strong, curved hoof, touches the ground. The remains of what were once two other toes grow as bony strips on the *cannon* bone of the horse's legs. The *frog* (an elastic

The bottom of a horse's hoof

WORLD BOOK illustration by Noel Sickles

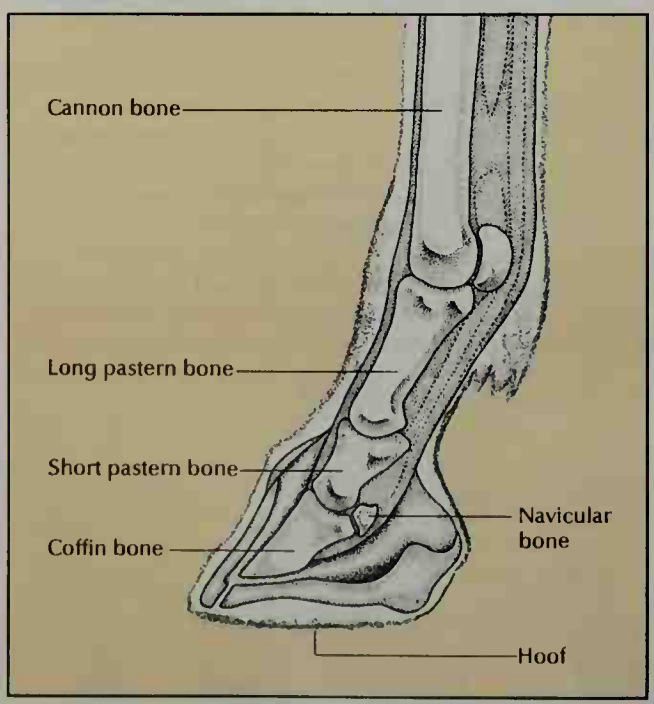


The skeleton of a horse



WORLD BOOK illustration by Noel Sickles and Patricia J. Wynne

The foot of a horse



WORLD BOOK illustration by Noel Sickles and Patricia J. Wynne

A horse's foot has a single toe, which is formed by the pastern bones and the coffin bone. A horse walks on the tips of its toes, each of which is covered by a strong, hard hoof.

mass on the sole of the foot) acts like a rubber heel. It helps absorb the jolt when the hoof strikes the ground. The horse's real heel bone is the *hock,* located about halfway up the leg. The hock never touches the ground.

A horse with a bad fracture usually cannot be saved because the break causes shock and extreme pain. But certain kinds of broken bones do not cause much pain and may heal. Veterinarians treat such breaks with slings and casts.

Teeth. Most male horses have 40 teeth, and most females have 36. The *molars* (back teeth) grind food as the horse chews. These teeth have no nerves, and they never stop growing. Sometimes the molars grow unevenly and must be filed down so the horse can chew properly.

An expert on horses can tell a horse's age by counting the number of teeth and checking their condition. Most foals are born toothless but soon get two upper and two lower front teeth. When 4 months old, the horse has four upper and four lower teeth. At the age of 1 year, it has six pairs of upper and lower *incisors* (cutting teeth). At 5 years, a horse has 12 pairs of incisors and is said to have a full mouth. Adult horses have six pairs of molars. Males grow four extra teeth at the age of 5. By the time a horse is 8 years old, the rough grinding surfaces of the bottom incisors have been worn down. The horse has a smooth mouth and is said to be *aged.* Sometimes tiny wolf teeth grow in front of the molars. These teeth inter-

fere with the *bit,* the part of a bridle that goes into the horse's mouth. Wolf teeth are usually removed. The bit rests in spaces between the horse's incisors and molars.

Senses. Horses have larger eyes than any other land animals except ostriches. A horse's eyes are oval, and they are set on the sides of the head. The two eyes can be moved independently, each in a half circle. Thus, a horse can look forward with one eye and backward with the other. Because of the position of its eyes, a horse has a blind spot a short distance in front of it. A horse must turn its head to see a nearby object that lies directly ahead. The shape of a horse's eyes makes objects far to the side or back appear to move faster than they actually do. For this reason, a horse may *shy* (move suddenly) at the slightest movement of an object to the side or back. Horses' eyes require a fairly long time to adjust to changes of light. When a horse is moved from a dark stall into bright sunlight, it may appear nervous until its eyes adjust.

Horses have keen hearing. They have short, pointed ears that they can move around to pick up sounds from almost any direction. Certain positions of the ears may indicate a horse's attitude. For example, when a horse points its ears forward, it is curious about an object in front of it. When a horse twitches its ears or lays them back against the head, it is angry and may kick.

Horses have a well-developed sense of smell. Their nostrils are very large and can pick up scents from long distances. A strong wind and heavy rain interfere with their sense of smell and may cause horses to become nervous.

The sense of touch varies among different breeds of horses. The thin skin of most breeds of light horses is sensitive to insects and rough objects. Most breeds of heavy horses are less sensitive to such irritations.

Intelligence. Horses can learn to follow signals, but they must be taught through constant repetition. They also must be encouraged to overcome their fear of unfamiliar objects and situations. Horses have excellent memories and can recall pleasant or unpleasant experiences many years after they occur.

Life history. A mare carries her foal for about 11 months before giving birth. This period may vary from 10 to 14 months. Foals can stand shortly after birth, and within a few hours they are able to run about. The legs of newborn horses seem much too long for their bodies. As the horse matures, the legs grow more slowly than the rest of the body.

A year-old colt is often more than half grown. Most horses reach full height and weight by the age of 5. Most horse raisers start to breed mares at the age of 3 or 4. They start to breed stallions at the age of 4. Most mares have five or six foals during their life, but some have as many as 19.

Race horses have their official birthday on January 1, except in countries of the Southern Hemisphere, where it is on either July 1 or August 1. Regardless of their actual birth date, these horses become a year older on their official birthday. This system is used to qualify horses for races and shows that are limited to certain age groups. For example, only 3-year-olds race in the Kentucky Derby. Most horses live from 20 to 30 years.

Equipment for horseback riding includes the rider's clothing, spurs, and whip. It also includes *tack* (gear) for the horse, such as the saddle and bridle.

Clothes for riding. Riders wear comfortable clothing suitable for their type of riding. Their clothes also must protect their legs from irritation while rubbing against the saddle. Blue jeans and a comfortable shirt are probably best for open-country riding. Cowhands often wear *chaps* (seatless leather trousers) that fit over their regular trousers. Chaps protect the rider's legs from being scratched by brush.

For English riding, *jodhpurs* (long, tight-fitting breeches) or regular riding breeches are usually worn. They provide both comfort and protection. Boots, or any laced shoes with heels, help keep the feet from slipping through the stirrups. Many riders wear hard caps to protect their head in case of a fall.

Spurs. Skilled riders use spurs to signal the horse without moving their legs or heels vigorously. Some riders in horse shows use spurs to give commands or to urge their mounts to run faster. Spurs should be worn only by expert riders.

Spurs called *dummy spurs* have either blunt *rowels* (little wheels) or no rowels. Some spurs have sharp points instead of rowels. *Racing spurs* have rowels on the inside to make it easy to touch the horse. Rowels on racing spurs and dummy spurs point downward. Most *dressage spurs* have sharp rowels. They curve upward so that riders need not shift their feet to touch the horse.

The whip. An expert rider uses a whip to give the horse special signals or to train the animal. Horse whips are lightweight and flexible and cause no pain if properly used. Horses learn to respond to signals from a trainer's whip when performing different steps and difficult movements in horse shows. Race horses increase their speed at a touch of the jockey's whip. A *riding crop* may be used like a whip. Crops have stiff handles. The tip is a large loop of rawhide or leather. In fox hunting, riders use a *hunting whip,* which has a curved, wooden or bone handle at one end and a long leather lash at the other end. The lash is used to control the hounds.

Experienced riders apply whips as punishment only if the horse kicks or bites at another horse or stubbornly disobeys a command. The rider immediately strikes the horse sharply on the flanks.

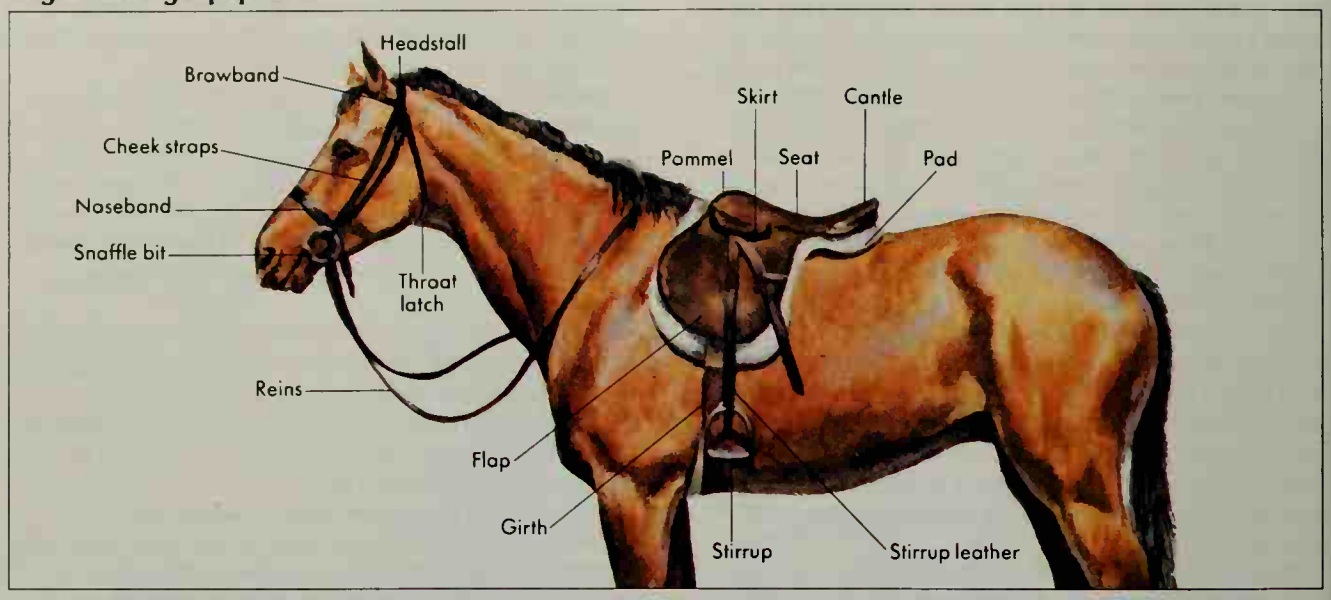
The saddle. Riders in the United States generally use an *English saddle* or a *Western saddle.* A person should use the kind of saddle that suits a particular type of riding.

The English saddle is flatter and weighs less than the

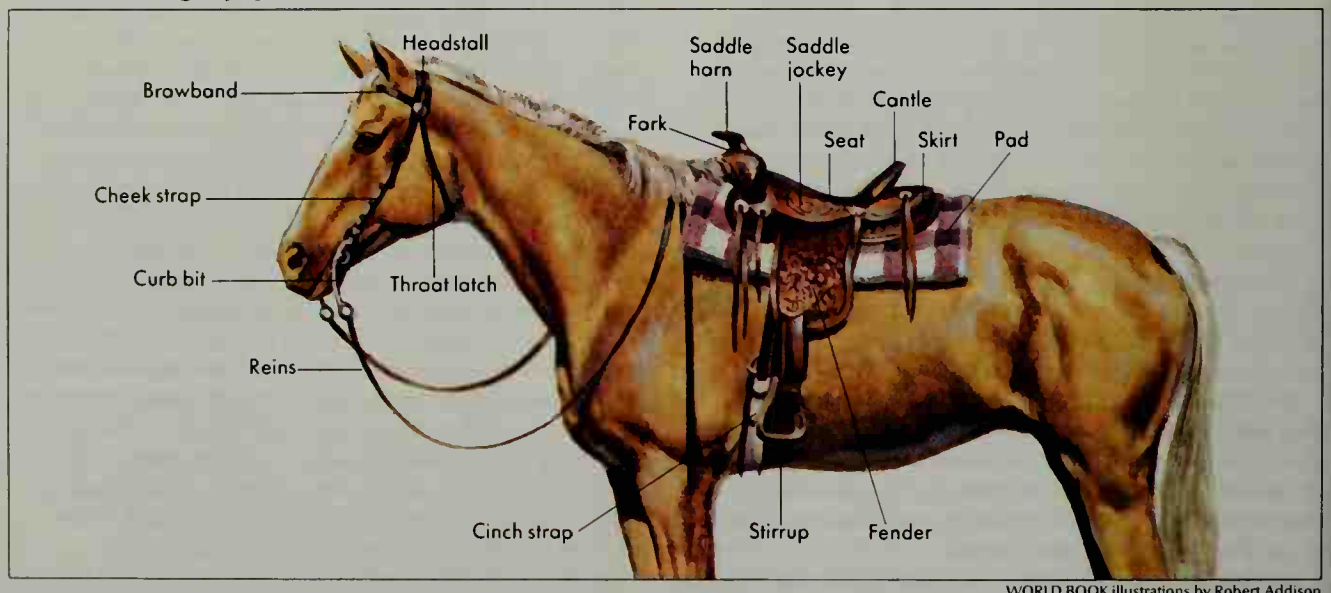
Riding equipment

Bit is the metal part of the bridle that fits in a horse's mouth.
Bridle is the headgear used to control a horse. It includes the bit.
Girth is a leather or canvas strap that fits under the horse's belly and holds a saddle in place.
Hackamore is a bitless bridle that controls the horse by pressure on its nose and jaw.
Reins are long, narrow leather strips attached at one end to the bit. The rider holds the other end.
Tack is riding equipment, such as the bridle and saddle.

English riding equipment



Western riding equipment



WORLD BOOK illustrations by Robert Addison

Western saddle. Jockeys, jumpers, exhibition riders, and others who need extra speed from their horses use the English saddle because it interferes with the horse's movements less than a Western saddle does.

The Western saddle has wide stirrups and a *horn,* to which a rope may be fastened. Cowhands and rodeo riders use Western saddles. Cowhands may tie their ropes to the horn when roping cattle. They usually use a *double girth* (two saddle straps) on the Western saddle to hold it securely against the pull of roped cattle. A blanket under the saddle keeps the horse's back and sides from becoming sore. Most Western saddles have fleece padding that also helps protect the horse's back.

The bridle is used to control the horse. It consists of straps and metal pieces that fit on the horse's head and in its mouth.

The simplest bridle is the *snaffle bridle.* This bridle has a jointed bit that is gentle on the horse. The bit of the snaffle bridle pulls on the corners of the horse's lips. The bridle's single set of reins can be handled easily by the rider.

The *double,* or *full, bridle* is used by advanced riders. This type of bridle has a double set of reins, a snaffle bit, and a *curb bit.* The curb bit fits between the horse's teeth on sensitive spaces called *bars.* This bit puts pressure on the horse's lower jaw. A separate set of reins controls each of the bits. The upper reins move the snaffle bit, and the lower reins operate the curb bit. Pressure on the snaffle bit causes the horse to raise its head. Pressure on the curb bit pulls the horse's head down and brings the animal to an abrupt halt. Polo players use the curb bit to stop their horses quickly.

Another kind of bridle, the *Pelham bridle,* combines the snaffle and curb bits into one bit with a double set of reins. Most Western bridles consist of only a curb or snaffle bit.

The art of riding and managing horses is called *horsemanship.* Many people enjoy riding horseback for fun and sport. The basic techniques of English and Western riding are similar.

Selecting a horse. The selection of a horse depends partly on the skill of the rider. Experienced riders may prefer responsive, high-spirited horses. But most beginners feel at ease on a gentle, reliable horse. Youngsters may be more comfortable on a pony than on a large horse. *Geldings,* which are male horses that have had their *testicles* (sex organs) removed, are easier to control than stallions or mares. In choosing a horse to buy, a person should also consider such factors as the animal's age, training, and physical condition. A well-trained horse over 10 years old is best for a beginning rider. An expert should ride the horse to determine how trained it is. In addition, a veterinarian should examine the animal and check for possible health problems.

Mounting a horse. The first things a rider learns are how to *mount* (get on) a horse and sit in the saddle.

The rider mounts on the horse's left side. Most horses become used to being mounted from the left side during training. Someone mounting from the right side might startle or confuse them. The custom of mounting from the left probably started when men wore long swords that hung down along the left leg. It was easier to throw the right leg across the horse's back than to throw the left leg and the heavy sword. Many horses trained to travel on mountain trails can be mounted from either side. Riders mount from the side that is less likely to cause the horse to lose its balance.

After mounting, the rider sits in a relaxed position. The rider should be settled firmly in the *dip* (middle of the saddle). The back is held erect but not stiff.

To start a horse, the rider squeezes both legs against its sides. As the horse moves forward, the rider lets the reins follow the movement of the horse's head. Riders should look where they are going, not at the horse.

To control a horse, riders use their hands, legs, and body weight. English riders call these skills the *aids.* Western riders refer to them as *cues.* Skilled riders can put their mounts through difficult performances and tricks with only slight movements of their hands or legs. Riders in horse shows change gaits time after time with no apparent signals. Cattle-herding horses and polo ponies respond quickly to cues. They start, stop, or turn at a touch of the rider's hand or leg, or at the shifting of weight.

Trainers teach horses to move *away from the leg.* The horse moves to the right when the rider's left leg presses against its side, and to the left when it feels the rider's right leg.

In English riding, horses are taught to move *toward the hand.* The reins in the rider's hands lead to the bit in the horse's mouth. When the rider pulls the right rein, the bit pulls on the right side of the horse's mouth. The horse then turns in that direction. Horses trained for Western riding learn to respond to the touch of the reins against the neck. The horse turns away from this signal. At a touch of the rein on the right side of the neck, the horse turns left.

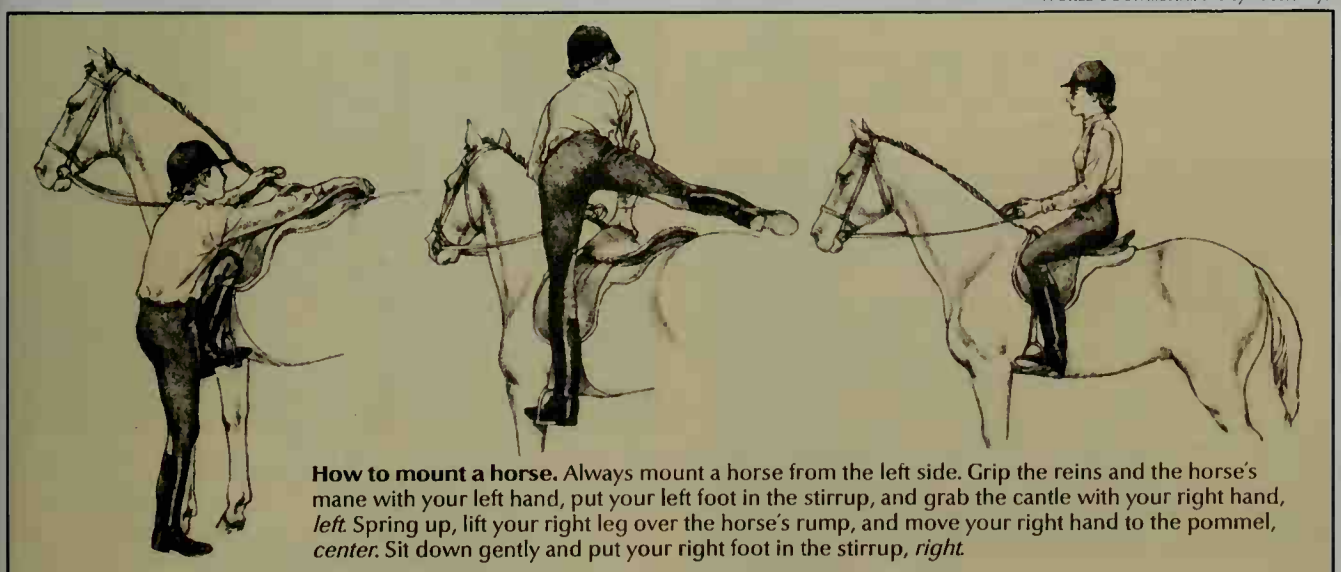
Skilled riders shift their weight in the direction of the horse's movement. They move forward when the horse goes forward, and to the right or left when turning. They also shift their body back a little in the saddle when slowing up or stopping. A good rider does all these things so smoothly that only the horse knows that the rider has changed balance.

To stop a horse, riders shift their balance back a little in the saddle. Then they squeeze their fingers to increase the pressure on the reins slightly without tugging on them. When the horse stops, the rider relaxes the pressure on the reins.

To move a horse backwards, the rider squeezes both reins equally, preventing the horse from moving forward, and presses both legs against the girth of the saddle. A well-trained horse will then step backwards.

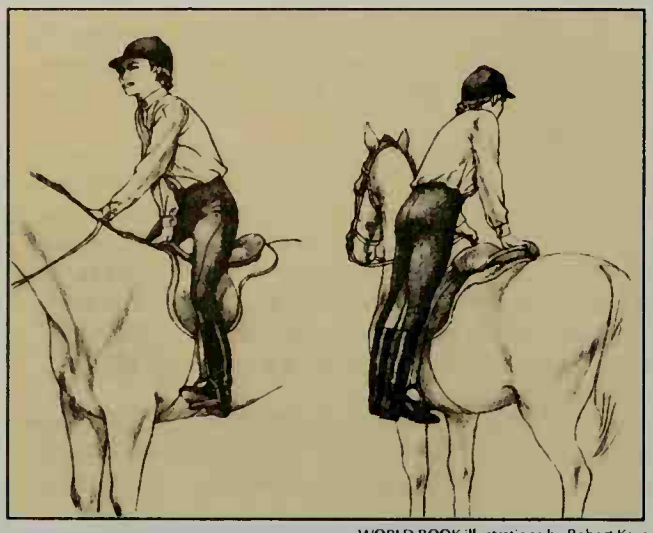
Gaits are the ways a horse moves. Horses have four natural gaits: (1) walk, (2) trot, (3) canter, and (4) gallop. Many horses are trained for three speeds within each of the four natural gaits. Trainers also develop artificial

WORLD BOOK illustrations by Robert Keys



How to mount a horse. Always mount a horse from the left side. Grip the reins and the horse's mane with your left hand, put your left foot in the stirrup, and grab the cantle with your right hand, *left.* Spring up, lift your right leg over the horse's rump, and move your right hand to the pommel, *center.* Sit down gently and put your right foot in the stirrup, *right.*

Holding the reins. The illustration at the left shows how to hold the reins. Keep your hands about 2 inches (5 centimeters) apart and slightly above the horse's withers.



WORLD BOOK illustrations by Robert Keys

How to dismount from a horse. Grip the reins and the horse's mane with your left hand and put your right hand on the pommel, *left.* Swing your right leg over the horse's rump and bring it next to your left leg, moving your right hand to the cantle, *right.* Balancing your body with your hands, remove your left foot from the stirrup and drop down.

gaits in some horses. Horses so trained compete in horse shows and perform in circuses, fairs, and rodeos. Artificial horse gaits include the pace, slow gait, and rack.

Walk is the slowest gait. The horse moves at a speed of about 4 miles (6 kilometers) an hour. It raises one foot after another and puts them down in the same order. The horse keeps its balance by altering its front and back feet, and its right and left feet. For example, the order may be (1) right forefoot, (2) left hind foot, (3) left forefoot, and (4) right hind foot.

Trot is a two-beat gait at a speed of about 9 miles (14 kilometers) an hour. The front leg on one side of the body and the hind leg on the other side hit the ground together. The horse bends its legs more when it is trotting than when it is walking. Harness-race horses trot while pulling a driver in a *sulky* (two-wheeled cart).

When beginners first ride at a trot, they should hold onto the horse's mane or the saddle until they get used to the motion. On the first beat of a trot, riders raise their body slightly by pushing their feet down on the stirrups. They come down in the saddle on the second beat and then go right up again. This method of riding, called *posting,* is used only in English riding. A beginner should practice the movements of posting while the horse is walking.

Canter is a comfortable, three-beat rhythmic riding gait. A horse canters at a speed of 10 to 12 miles (16 to 19 kilometers) an hour. On the first beat, one hind foot strikes the ground. Then the other hind foot and opposite forefoot hit the ground together. On the third beat, the other forefoot strikes the ground.

Gallop is a horse's fastest natural gait. It consists of four beats. For the first two beats, the hind feet strike the ground one after the other. On the third and fourth beats, the forefeet hit the ground in the same order as the hind feet. Then the horse leaps forward, and all its feet leave the ground. A racing horse runs at an extended gallop.

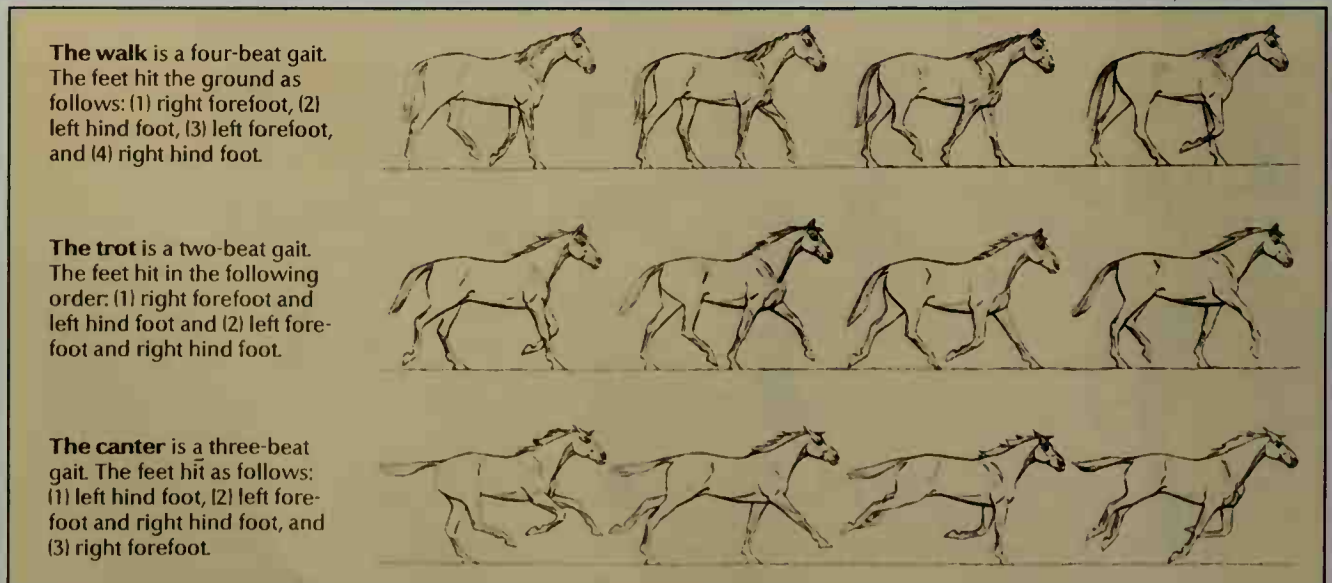
Pace, like the trot, is a gait used in harness racing. When a horse paces, it moves the legs on the same side of the body at the same time. The pace is an uncomfortable riding gait.

Slow gait is a slow, four-beat gait. Four beats of the hoofs can be heard as the horse moves forward.

Rack is a fast, smooth, four-beat gait. It resembles the slow gait but is faster. Five-gaited saddle horses are trained to slow gait and rack.

Three of the horse's natural gaits

WORLD BOOK illustrations by H. Charles McBarron



The stall. A horse should live in a clean, comfortable stall that measures at least 10 feet by 10 feet (3 meters by 3 meters). The stable should be light, dry, and well ventilated. Clay or finely ground cinders make the best floor, but cement or wooden floors covered with rubber stall mats can be used. Bedding spread at least 1 foot (30 centimeters) thick over the floor gives the horse a comfortable resting place. Wood shavings, sawdust, straw, rice hulls, or peat moss make good bedding materials. Horses can sleep standing up and often doze while standing with their eyes wide open.

Food. A horse needs food at least three times a day. The horse's stomach is small for the size of its body and holds about 18 quarts (17 liters) of food. In comparison, a man's stomach holds little more than 1 quart (0.95 liter) of food.

Horses eat grass, grain, and hay. When a horse eats grain or hay, it gathers the food with its lips. When a horse eats grass, it bites off the blades close to the ground. Horses chew their food slowly and thoroughly. They do not chew a cud as do cows and deer.

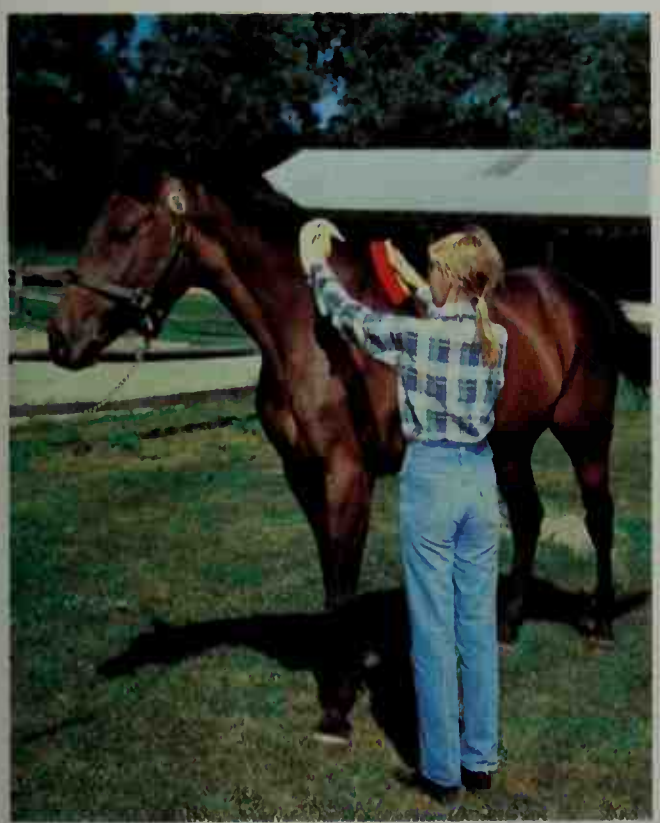
Hay for horses should be placed in a net or on a *rack* (wooden frame). An open box called a *manger* holds the grain. A 1,000-pound (450-kilogram) horse that works three or four hours per day needs about 20 pounds (9 kilograms) of hay—10 pounds (4.6 kilograms) in the morning and the rest at night. Horses should never eat moldy or dusty hay or hay that contains coarse sticks, thorns, or rubbish. Timothy, or timothy mixed with clover or alfalfa, makes the best kind of hay.

Horses prefer oats more than any other grain. Working horses may eat from 4 to 12 quarts (3.8 to 11.4 liters) of grain, fortified with vitamins and minerals, every day. The exact amount depends on the animal's size, condition, and the amount of exercise it gets. A third of the feed should be given in the morning, a third at noon, and the rest at night.

Most horses require from 10 to 12 gallons (38 to 45 liters) of fresh, clean water daily. A horse should not be permitted to drink large amounts of water immediately after exercise, when the animal is hot.

Horses need salt for good health because their bodies lose salt when they sweat. A horse eats about 2 ounces (57 grams) of salt daily. A box of salt or a solid salt block in the stable and in the pasture provides this important part of the diet.

Grooming helps keep a horse healthy and improves its appearance. Horses kept in a stable should be groomed daily with a rubber currycomb, body brush, hoof pick, and mane and tail comb. Long, sweeping brush strokes in the direction of the growth of the hair help give the coat a healthy glow. Brushing removes dirt and dandruff. Areas touched by the saddle and girth, and the regions behind the heels and in the hock depressions, need special brushing. A thorough wiping with a soft cloth should follow the brushing. The hoof pick removes dirt and stones and other objects from the feet.



Daily grooming of a horse's coat and mane helps maintain the animal's health and improves its appearance. The coat should be brushed thoroughly and then wiped with a soft cloth, *above*. The mane should be combed to untangle the hairs, *right*.

Cleaning a horse's hoofs is part of the daily care that the animal should receive. A hoof pick should be used to remove dirt and stones and other objects from the hoofs, *above*.

WORLD BOOK photos

John Messineo, Tom Stack & Assoc.

Medical care of a horse includes periodic examinations by a veterinarian. As part of an examination, the doctor checks the condition of the animal's teeth and mouth, shown here.

Shoes protect the feet of horses that run or work. Light shoes, weighing about 8 ounces (230 grams) and having only a few nails, make the best shoes for most horses. Saddlebreds and Tennessee walking horses wear shoes weighted in the toes to help them raise their feet high. Race horses wear light shoes that may wear out after a few races. Shoes for wear in winter or for high mountain trails have cleats that help keep the horse from slipping on ice or snow.

Medical care. Horses should be examined by a veterinarian at least once or twice a year. They should be vaccinated against tetanus, influenza, and other diseases. When necessary, they should receive medicine to expel worms. Sometimes, a horse's teeth must be *floated* (filed down to remove sharp edges).

Horse owners can prevent many medical problems by feeding and bedding the animals properly, keeping them and their living quarters clean, and exercising the horses daily. Owners should watch for any changes in the condition or behavior of their horses and call a veterinarian if a horse appears ill. Signs of illness include loss of appetite, lack of vigor, mucous or bloody discharges from the eyes or nose, swellings or sores on the body, and hot legs or feet. A fast or slow breathing rate or pulse rate may also be a sign of illness. Normally, a resting horse breathes from 8 to 16 times per minute and has a pulse rate of from 30 to 40 beats per minute.

A horse's legs and feet easily become diseased if not cared for properly. Some common diseases of the legs and feet include *thrush, navicular,* and *laminitis.* Thrush is an infection of the frog. It can be prevented by providing clean, dry bedding for a horse. To treat thrush, veterinarians apply medication to the affected frog. Navicular is a disease of the foot bone that causes a horse's legs to become stiff and sore. It is treated with corrective shoeing and drugs. Laminitis, also called *founder,* is an inflammation of the foot. Its symptoms include lameness, hot feet, and increased pulse rate. Laminitis is treated by applying medication and soaking the foot in warm water.

Horse shows and sports involving horses include a variety of events that test the speed, strength, and other abilities of the animals. Success also depends on the skill of the riders or drivers. Horse shows and sports increased greatly in popularity during the 1900's. Today, they are enjoyed by millions of people worldwide and include local, national, and international competitions.

The Olympic Games have three kinds of *equestrian* (horseback riding) sports: (1) jumping, (2) dressage, and (3) eventing. The International Equestrian Federation regulates the Olympic equestrian events. It also regulates the world championships in *driving,* an event for harness horses and drivers. More than 60 nations belong to the federation.

This section describes horse shows, jumping, dressage, and eventing. *World Book* has separate articles on **Fox hunting; Harness racing; Horse racing; Polo; Rodeo; Steeplechasing.**

Horse shows have three main types of competitions: (1) performance, (2) breeding, and (3) *equitation* (horsemanship). In performance competition, the horses and riders demonstrate various skills. For example, a show may include jumping, five-gaited riding, or driving events. In breeding competition, all the horses in the event must be of the same breed. They are displayed without saddles. The judges rank the horses on *conformation* (physical qualities) and decide which ones best represent the breed. In equitation competition, the contestants ride their horses around a ring. They are judged on their riding style and control of the horse. Some equitation events include jumping.

Some horse shows are restricted to only one breed of horses. Others include events for many breeds. Shows may be held indoors or outdoors and may last from a few hours to a week or more.

Robert Frerck

A jumping course consists of different types of obstacles that the contestants must clear. The course shown here includes such standard obstacles as a stone wall and parallel bars.

Karl Leck

A well-performed jump requires harmony between the rider and horse. For example, the rider must adapt to the horse's movements and, as shown above, lean forward for the jump.

Many organizations sponsor horse shows in the United States. The American Horse Shows Association (AHSA) approves about 2,000 shows a year, including the trials for the United States Equestrian Team. The U.S. Equestrian Team represents the United States in the Olympic Games and other international competitions. Important U.S. horse shows include the National Horse Show in East Rutherford, New Jersey; the American Royal Horse Show in Kansas City, Missouri; and the Grand National Horse Show in San Francisco, California.

Jumping. In jumping competitions, the contestants ride across a specially designed course that has obstacles for the horses to leap over. The course may include high jumps, wide jumps, and two or more jumps set close together. The courses vary in difficulty, depending on the level of the competition. The contestants in jumping competitions receive *faults* (penalties) for falls, knocking down the top part of an obstacle, *refusals,* and other errors. A refusal occurs when the horse will not jump over an obstacle. After three refusals, the horse and rider are eliminated from the competition. The contestant with the fewest faults wins the event. In some jumping events, the contestants are timed. In case of a tie for first place, the contestant who completes the course in the shortest time wins.

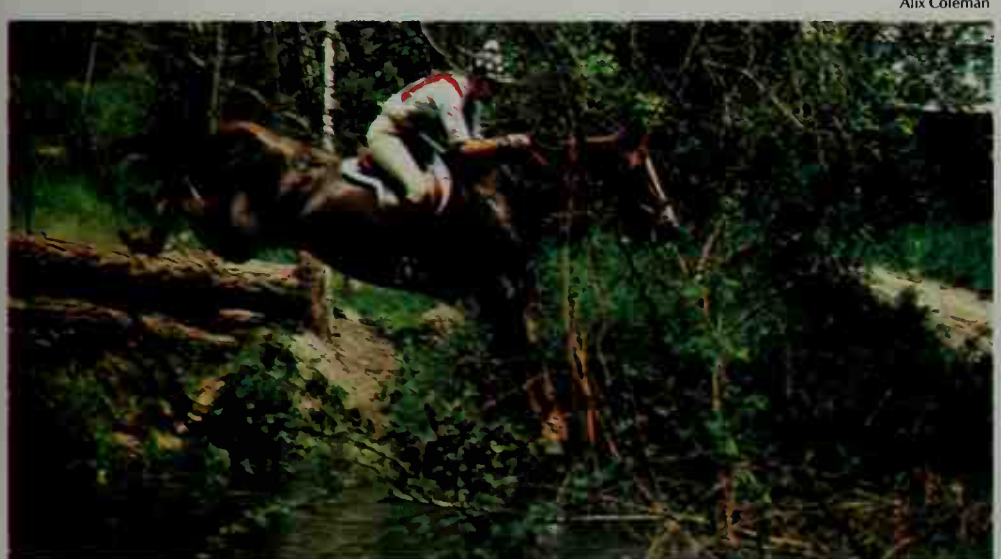
The main kinds of jumping competitions include (1) Nations' Cup, (2) puissance, and (3) Grand Prix. In Nations' Cups, teams from different countries compete. In most cases, each team consists of four riders and their horses. The three best scores of each team are added to determine the winning team. Puissance events consist mainly of high jumps. The contestants who complete the course without any faults or with equal faults participate in a jump-off. In the jump-off, the number of obstacles is reduced, but the remaining obstacles are raised or widened. The contestants may have several jump-offs, until all except the winner fail to clear the obstacles. Obstacles may reach a height of 7 feet (2.1 meters) or more. In Grand Prix competitions, all contestants complete the course once, and then the top two or more riders participate in a jump-off. In case of a tie, the contestant who completes the course in the shortest time wins. Grand Prix events are held at major horse shows and as part of the Olympic Games.

Dressage. In dressage competitions, the riders guide their horses through a series of movements at the walk, trot, and canter, using mainly leg and seat signals. The horse's movements should be smooth, precise, and graceful, and the rider's signals should not be visible to the spectators.

Special dressage movements include the *passage, piaffe,* and *pirouette.* A passage is a rhythmic, elevated trot in which the horse slowly moves forward. A piaffe resembles a trot, but it is performed without any forward, backward, or sideward movement. A pirouette is a circle that the horse makes by pivoting its forelegs and one hind leg around the other hind leg.

In dressage competitions, the series of movements

Alix Coleman



The cross-country event is the most strenuous part of a type of equestrian competition called *eventing.* The contestants must ride over rough terrain, crossing streams and other obstacles.

Alix Coleman

Dressage competition consists of a series of smooth, graceful movements performed by the horse in response to signals by the rider. These signals should not be seen by the spectators.

must be performed in a specific order. In most cases, the contestants are judged by two or more officials who sit in various places around the ring. Each judge gives a contestant points for the performance of each movement and penalties for errors. The scores of all judges are added, and the contestant with the most points wins.

Dressage techniques were originated by military officers who rode horseback. They had to use their hands to hold weapons, and so they gave signals to their horses with their legs and by shifting their body weight.

Eventing is often called the *Three-Day Event* because most major competitions take place during a three-day period. The contestants first compete in a dressage event. They then participate in a cross-country event. They ride over a course that may be more than 10 miles (16 kilometers) long and includes rough terrain and such obstacles as brush hedges, rail fences, and streams. The contestants receive penalties for falls, refusals, and failure to complete the course in the allotted time. Lastly, a stadium jumping competition is held. The results from the events of the three days are added, and the contestant with the fewest penalties wins.

Eventing is probably the most challenging event. It tests the endurance, obedience, jumping ability, and other qualities of the horse and the skill and daring of the rider. The cross-country event is very strenuous.

Raising horses

Raising horses for racing, driving, and other sports involves careful breeding and training. It is an important industry in the United States. California, Florida, Kentucky, New York, Texas, and many other states have large breeding farms that raise horses.

Breeding horses. On breeding farms, stallions and mares are carefully selected for mating on the basis of their ancestry and physical qualities. Breeders of race horses also consider racing records of the animals. An owner of a champion racing stallion may earn millions of dollars in *stud fees.* A stud fee is a sum of money paid to a stallion's owner for the use of the stallion to sire a foal. Breeding horses is not an exact science, and breeders can never be completely certain of producing a colt or filly of champion quality.

Most breeders mate their mares to a stallion in spring. The mares give birth about a year later. People who raise race horses in the Northern Hemisphere want their foals to be born is soon as possible after January 1 because the foals will be considered yearlings the following January. In the Southern Hemisphere, people want foals born soon after the start of July or August. A foal that is born early in the year has more time to grow and develop before it races as a 2-year-old.

A foal stays with its mother for its first four to six months. The owner then *weans* (separates) the foal from its mother and puts it out to pasture with other foals.

People who raise purebred horses enter their foals in the *registry* of the association for the particular breed.

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Raising horses is an important industry in the United States. On breeding farms like the one at the left, experts breed and train horses for racing, driving, and other sports.

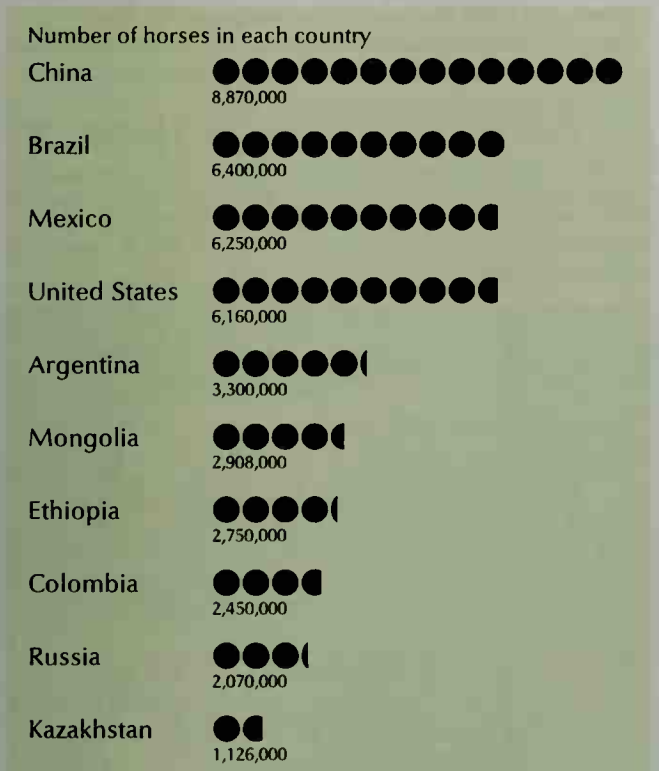
William Strode, Woodfin Camp, Inc.

A newborn foal is cared for by its mother. The mare nurses the foal for the first four to six months after birth. The owner then *weans* the foal by separating it from the mother and putting it out to pasture with other foals.

A registry is a record listing a horse's sire and dam and other information. Horses that appear in a registry are called *registered horses*. In the United States, there are about 70 breed associations with registries. The two largest associations are the Jockey Club, for thoroughbreds, and the American Quarter Horse Association.

Other countries also have breed associations and registries. These nations, which are known for breeding fine horses, include Argentina, France, New Zealand, and the United Kingdom.

Leading horse-raising countries



Figures are for a three-year average, 1997-1999.
Source: Food and Agriculture Organization of the United Nations.

Training horses requires great skill and patience. Expert trainers handle horses gently but firmly and teach them slowly. Soon after birth, a foal learns to accept handling by human beings. Some trainers begin to accustom a foal to a halter almost immediately. Others do not halter-break foals until they are several months old. After a horse is 1 year old, the trainer gradually accustoms it to having a saddle on its back. Then the horse is mounted and ridden a few steps. Most horses that are trained slowly and patiently do not buck when they are mounted for the first time.

A harness horse is also trained in gradual steps. The horse is first taught to respond to signals from long reins, which are held by a person who walks behind the animal. Later, the horse is taught how to pull a light buggy or carriage.

After a horse has learned to follow the signals of a rider or driver, it is trained for a certain sport. For example, thoroughbred race horses learn to run when a starting gate swings open. Harness racing horses learn to trot or pace behind a moving starting gate that is attached to a car.

WORLD BOOK photo

Training a colt to lead. A colt learns to *lead*—that is, to follow a person who guides it with a strap—by being led around a ring behind its mother. The colt follows naturally.

Prehistoric cave painting (about 15,000 B.C.) by an unknown artist; Lascaux Cave, Dordogne, France (Jean Vertut)

Prehistoric paintings of horses have been found in many caves in Europe. The painting shown above, from the Lascaux Cave in southwestern France, is about 17,000 years old.

Origins of the horse. Scientists believe that the earliest ancestor of the horse was a small animal about 10 to 20 inches (25 to 51 centimeters) high. They call this animal *Eohippus* (dawn horse) or *Hyracotherium.* It lived about 55 million years ago in what is now North America and Europe.

These prehistoric horses had arched backs and snout-like noses. They looked more like racing dogs, such as greyhounds or whippets, than like the straight-backed, long-faced modern horse. They had four toes on their front feet and three toes on their hind feet. Each toe ended in a separate small hoof. Large, tough pads similar to those on a dog's foot kept the toes off the ground. These pads bore the animal's weight.

The next important ancestor of the modern horse was *Mesohippus* (middle horse). It lived about 35 million years ago. It averaged about 20 inches (51 centimeters) in height and had long, slender legs. Each foot had three toes, of which the middle toe was longest. About 30 million years ago, it gave way to a new horselike creature, *Miohippus.* This animal stood from 24 to 28 inches (61 to 71 centimeters) tall, and its middle toe was longer and stronger than that of its ancestors.

Horselike animals continued to develop, and *Merychippus* (ruminant or cud-chewing horse) appeared about 26 million years ago. It grew about 40 inches (102 centimeters) high. Like Miohippus, it had three toes on each foot. The side toes were almost useless, but the center toe grew long and strong. It ended in a large, curved hoof and bore all the animal's weight.

By about 3 million years ago, horses probably looked somewhat like modern horses. They grew larger than their ancestors. The side toes on their feet became short bones along the legs, leaving the strong center toe with its hoof to support the animals. The teeth also changed, becoming better fitted for eating grass. Scientists group these horses, along with the modern domestic horse, under the name *Equus.*

No one knows where horses originated. Fossils show that during the Pleistocene Epoch horses lived on every continent except Australia. Great herds wandered over North and South America. Then, for some unknown reason, they disappeared from the Western Hemisphere.

Horses and people. Primitive people hunted horses and ate their meat. No one knows who first tamed horses and trained them for riding. Scientific discoveries at the ancient city of Susa, located in southwestern Asia, show that people rode horses about 5,000 years ago.

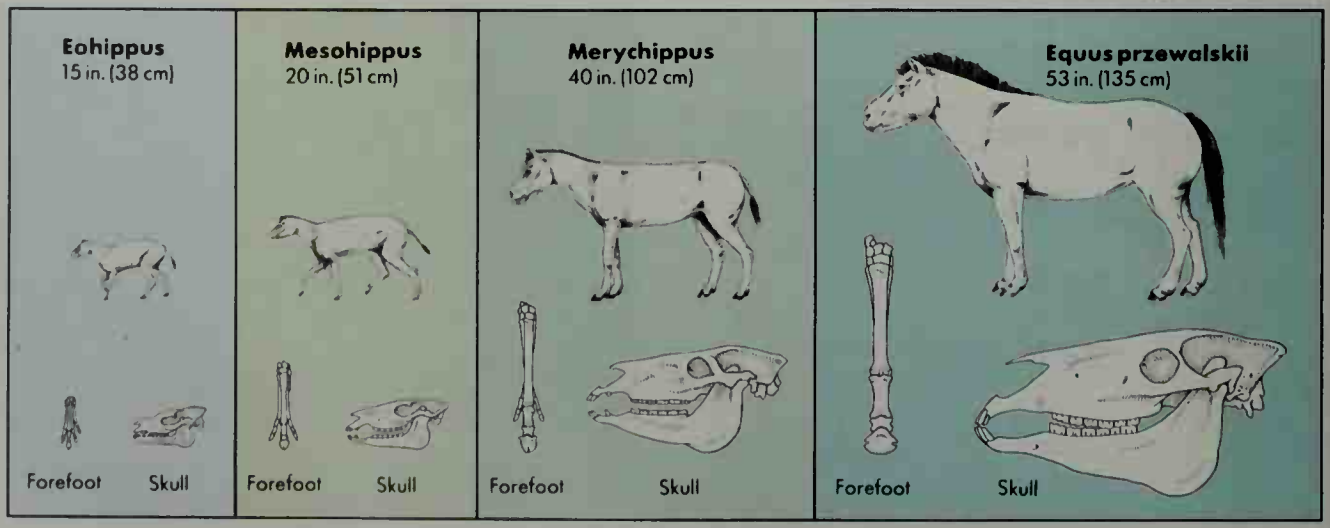
Stone tablets show that the Hittites trained horses for sport and war about 1400 B.C. The Assyrians, about 800 B.C., hunted lions in two-wheeled chariots drawn by a pair of horses. Tapestries show early Persians playing a kind of polo. The early Greeks and Romans were expert riders and used horses for racing and other sports. Greek and Roman soldiers rode horses in battle. The Greeks wrote about horsemanship as early as 400 B.C. We still follow their principles of riding.

In 1066, William the Conqueror used mounted

The development of the horse

The illustrations below show some of the ancestors of the modern horse. The earliest ancestor, *Eohippus,* lived about 55 million years ago. Various horselike creatures gradually developed over millions of years, changing in size and other body features. For example, the many-toed feet of early horses developed into the single-toed hoofs of today's horses.

WORLD BOOK illustrations by Jean Helmer and Patricia J. Wynne



The Metropolitan Museum of Art, Gift of John D. Rockefeller, Jr., 1933

Ornamented horses are led by a man paying tribute to his king. This piece of wall relief of the 700's B.C. comes from the palace of the ancient Assyrian ruler Sargon II, near Mosul, Iraq.

Famous horses in history and legend

Al Borak carried Muhammad from earth to the seventh heaven, according to Muslim legend.
Aristides won the first Kentucky Derby in 1875.
Black Horse, from the Bible (*Revelation*), is the horse of Famine.
Bucephalus could be ridden only by Alexander the Great, who founded the city of Bucephala about 326 B.C. in honor of his beloved horse.
Bulle Rock was the first thoroughbred imported from England to America, in 1730.
Cincinnati, a great black charger, carried General Ulysses S. Grant during the Civil War.
Clever Hans, who lived in the early 1900's, was a famous "talking" horse that solved arithmetic problems.
Comanche, a cavalry horse, was the only survivor of Lieutenant Colonel George A. Custer's "last stand" in 1876. **Vic,** Custer's horse, died in the battle.
Copenhagen carried the Duke of Wellington to victory in the Battle of Waterloo in 1815.
Diomed won the first English Derby at Epsom Downs, in 1780.
Eclipse, an English thoroughbred foaled in 1764, was the ancestor of many modern thoroughbreds.
Incitatus was made a priest and consul by the Roman Emperor Caligula about A.D. 40. This horse had an ivory manger and drank wine from a golden pail.
Iroquois, in 1881, became the first American-bred horse to win the English Derby.
Marengo, a white stallion, was ridden by Napoleon in his defeat at Waterloo in 1815.
Pegasus was the great winged horse of the Muses (nine goddesses in Greek mythology). See **Pegasus.**
Reckless, a small Korean racing mare, served as ammunition carrier for a U.S. Marine platoon during the Korean War (1950-1953). The mare was made a sergeant and received a medal for bravery under fire.
Sleipnir, the gray horse of Odin, chief god in Norse mythology, was said to have eight legs and be able to travel on land or sea.
Traveller, a spirited gray gelding, carried General Robert E. Lee during the Civil War. See **Lee, Robert E.** (picture).
Trojan Horse, a legendary wooden horse built by the Greeks, helped them capture the city of Troy during the Trojan War.
Xanthus was the horse of Achilles. He was supposed to have predicted his master's death, after being scolded by the mighty Greek warrior.

knights to invade England. The English then began to breed large, powerful war horses that could carry a man wearing a heavy suit of armor. During the 1300's, after armies began using gunpowder, swift, light steeds replaced the large mounts of the knights as war horses.

From the late 1500's onward, breeders in Europe developed improved stocks of horses, largely from Arab horses. Arabs had lived in Europe for hundreds of years. But in the 1600's, breeders took a new strain of Arab horse to Britain and used it as the basis of the thoroughbred. In the 1700's, King Louis XV of France founded an important breeding center called the Pompadour stud. Later, Napoleon ordered the importation of more than 200 Arab stallions and 30 mares to improve the French stock even more. Arab breeding centers soon spread to Germany and other countries.

The first European colonists found no horses in North America. Christopher Columbus had brought horses with him on his second voyage to the New World. But most American Indians did not know about horses until Spanish conquerors brought them to Mexico in 1519. Horses that the Spanish explorers left behind probably became the ancestors of the American wild horses.

The Indians, especially the tribes of the western plains, began to use horses about 1600. Indians rode horses to hunt buffalo and used them in battle.

Horses played an important part in the development and exploration of North America. The pioneers who settled the West rode horses and used them to pull

The Metropolitan Museum of Art, New York, Fletcher Fund, 1919

A European war horse was large and strong enough to carry a heavily armored knight into battle. This print by Albrecht Dürer, a German artist, dates from the early A.D. 1500's.

Bettmann Archive

Automobiles began to replace horse-drawn carriages during the early 1900's. Horses lost importance in transportation as the use of motor-driven vehicles became widespread.

their covered wagons. Mounted soldiers fought in the Revolutionary War in America (1775-1783) and in the American Civil War (1861-1865).

Horses pulled trains on short railroads until the steam locomotive replaced them about 1830. They pulled *horsecars* (streetcars) before the use of electric power. Horses also served as the fastest means of communication until the telegraph was developed during the 1800's.

With the creation of railroads, tractors, trucks, and automobiles, horses became less useful. The number of horses in cities and farms declined steadily. But, though the use of horses for heavy work decreased, their importance in sports and recreation increased.

During the 1900's, the number of wild horses declined greatly in the United States and other countries. Many people feared that wild horses were becoming extinct, especially because the horses were being hunted for their meat. As a result, numerous countries have passed laws protecting wild horses. Stephen Duren

Scientific classification. Horses belong to the horse family, Equidae. They are classified as genus *Equus,* species *E. caballus.*

Related articles in *World Book* include:

Kinds of horses

Bronco
Mustang
Przewalski's horse
Shetland pony

Members of the horse family

Donkey
Mule
Onager
Zebra

Diseases of horses

Distemper
Glanders
Heaves
Mange
Spavin

Sports

Fox hunting
Harness racing
Horse racing
Kentucky Derby
Olympic Games (table: Equestrian)
Polo
Rodeo
Steeplechasing

Other related articles

Bonheur, Rosa (picture)
Bot fly
Centaur
Cowboy
Harness
Hoof
Horse fly
Kentucky (pictures)
Pegasus
Saddle
Ungulate

Outline

I. Kinds of horses
- A. Light horses
- B. Heavy horses
- C. Ponies
- D. Wild horses

II. The body of a horse
- A. Size
- B. Coat and skin
- C. Legs and hoofs
- D. Teeth
- E. Senses
- F. Intelligence
- G. Life history

III. Riding equipment
- A. Clothes for riding
- B. Spurs
- C. The whip
- D. The saddle
- E. The bridle

IV. How to ride
- A. Selecting a horse
- B. Mounting a horse
- C. To start a horse
- D. To control a horse
- E. To stop a horse
- F. To move a horse backwards
- G. Gaits

V. Care of a horse
- A. The stall
- B. Food
- C. Grooming
- D. Shoes
- E. Medical care

VI. Horse shows and sports
- A. Horse shows
- B. Jumping
- C. Dressage
- D. Eventing

VII. Raising horses
- A. Breeding horses
- B. Training horses

VIII. Horses in history

Questions

What does a *hand* mean in measuring a horse?
What are the three kinds of equestrian sports in the Olympic Games?
What are the horse's three natural gaits?
Why do horses need salt in their diet?
What did the earliest known ancestor of the horse look like?
How do you start and stop a horse when riding?
Why do owners sometimes cover horses with blankets?
How many teeth does a full-grown horse have?
What are the *aids* or *cues*? How are they used?
Which are the strongest horses?

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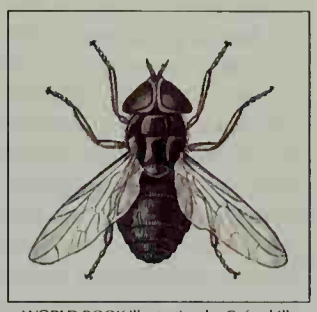
Horse bean. See Broad bean.
Horse brier. See Greenbrier.
Horse chestnut. See Horsechestnut.
Horse fly is a name for certain types of stout-bodied flies that live near water in pastures, fields, and forests. The adult male horse fly feeds on flower pollen and nectar. The female bites and sucks the blood of horses and other livestock, as well as people.



WORLD BOOK illustration by Oxford Illustrators Limited

Horse fly

The female horse fly lays eggs in bunches on plants that grow in wet soil or hang over water. The wormlike *larvae* (young) develop in the mud and eat worms and other small animals. The eyes of the male horse fly are large and touch at the top of the head. The female's eyes are smaller and do not touch.

Some female horse flies carry diseases, such as tularemia and anthrax. They transmit the infection from one animal to another when they bite. Horse flies are difficult to control. Oil sprays and pyrethrum sprays have been used successfully to kill the adult flies. Sandra J. Glover

Scientific classification. Horse flies are members of the order Diptera and belong to the horse fly and deer fly family, Tabanidae.

See also Fly (with picture: A horse fly's eyes).

Horse latitudes are regions noted for their lack of winds. They lie at about 30° north and 30° south latitude, between the belts of the trade winds and the prevailing westerlies. Sailors were the first to call these regions the *horse latitudes,* perhaps because many horses died on sailing ships delayed there by the lack of wind. In the horse latitudes, air tends to sink toward the earth's surface, and rainfall is light. Most of the world's major deserts, including the Australian Desert and the Sahara in northern Africa, lie at the horse latitudes. Mark A. Cane

See also Calms, Regions of.

Horse racing is an internationally popular sport based on the speed of horses. Horse racing is also a major form of gambling, with billions of dollars wagered annually, and a multibillion-dollar industry.

There are four major forms of horse racing. In thoroughbred racing, quarter horse racing, and steeplechase racing, jockeys ride the horse. In harness racing, the horse pulls a driver in a two-wheeled carriage called a *sulky.* Thoroughbred races are usually held on a flat oval track, though European tracks differ widely in layout. The typical quarter horse race is conducted on a straight flat track and is a short sprint, with a quarter mile (0.4 kilometer) the most common distance. Quarter horse racing is a regional sport, most popular in the southwestern and western United States. In a steeplechase, jockeys ride horses over obstacles.

This article discusses thoroughbred horse racing. For information on harness races and steeplechases, see Harness racing and Steeplechasing.

Thoroughbred horses

The ancestry of all thoroughbred horses can be traced to three Arabian stallions—the Byerly Turk, the Darley Arabian, and the Godolphin Arabian (sometimes called the Godolphin Barb). The three horses probably originated in the Middle East and were brought to England in the late 1600's and early 1700's. They were mated with English mares in an attempt to produce superior race horses. Each of the three male lines is traced through a single descendant—the Byerly Turk through a horse called Herod, the Darley Arabian through a horse named Eclipse, and the Godolphin Arabian through one

© Jerry Wachter, Focus on Sports Inc.

Race horses gallop into the first turn of the track as the crouching jockeys maneuver for position. Thousands of excited racing fans cheer for their favorite horses.

called Matchem.

Before the end of the 1700's, the English had developed a new breed of race horse called the thoroughbred. The breed displayed a remarkable ability to carry weight with sustained speed over extended distances.

A typical thoroughbred weighs from 1,000 to 1,200 pounds (450 to 545 kilograms) and stands from 62 to 65 inches (157 to 165 centimeters) high. Height is measured in *hands*, from the ground to the highest part of the horse's back, known as the *withers*. One hand equals 4 inches (10 centimeters).

In the Northern Hemisphere, the age of a thoroughbred race horse is figured as if its birthday were January 1 rather than the actual month and day of its birth. A newborn thoroughbred is called a *foal* until January 1 of the year after it was born, when it becomes a *yearling*. In the Southern Hemisphere, the official birthday of race horses is either July 1 or August 1 depending on the country. A male horse is known as a *colt* until he turns 5, when he is called a *horse*. A female is called a *filly* until the age of 5, when she is known as a *mare*. A male castrated horse of any age is called a *gelding*. A male parent is a *sire*, and a female parent is a *dam*.

Thoroughbreds are required to carry a certain weight in a race. Most jockeys weigh 115 pounds (52 kilograms) or less. The total weight consists primarily of the jockey's weight plus the saddle and sometimes padded lead weights inserted into pockets in the saddle. In many races, the weight is determined by the horse's record. The more successful a horse has been, the more weight it is assigned. In some races, weight is assigned according to the horse's age or sex. Younger or female horses often carry less weight than older or male horses.

Jockeys and trainers

Jockeys. A jockey's skill can determine the outcome of many races. Jockeys beginning their careers as apprentices receive a weight allowance that varies from country to country.

The jockey's equipment consists of boots, saddle, whip, spurs, safety helmet, and goggles. The horse's owner provides the jockey's uniform shirt and cap, called *silks*. The colors of the silks identify the owner and horse for spectators, along with a number that appears on a cloth beneath the saddle.

Trainers resemble the coaches of other sports. Trainers are responsible for the horse's condition and for planning the strategy of a race with the jockey. A trainer operating a public stable trains horses for several owners. A trainer with a private stable has an exclusive arrangement with a single owner. Trainers are paid a daily rate and also receive a percentage of the money that owners earn from races.

In major European racing countries, such as England, Ireland, and France, trainers board their thoroughbreds in facilities called training yards and train them there. The horses are transported by van from the yards to the race tracks. Nearly all trainers in North America have stalls in barns at the racetrack and train the horses on the track between 5 a.m. and 10 a.m.

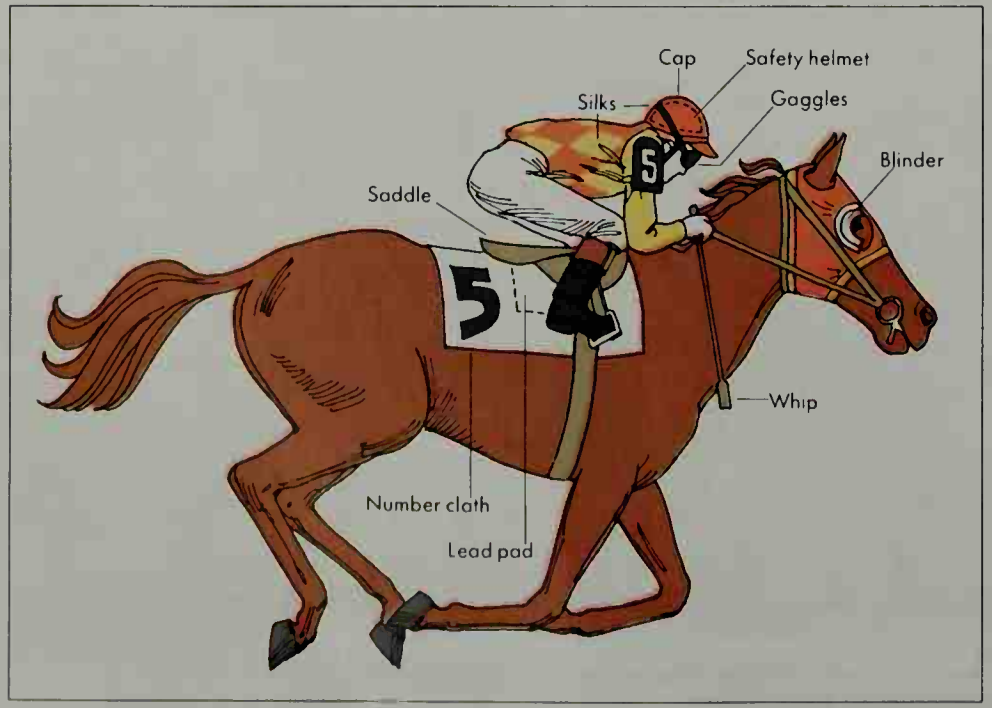
Types of horse races

Owners of thoroughbreds compete for prize money, called the *purse*. In most races, the first four or five finishers in a race share the prize money, with the winner collecting 60 percent. The race track pays the purse.

Stakes races are the most important races. They offer the largest purses and attract the best horses. Owners pay fees to enter their horses in such races, and the fees are added to the purse paid by the track.

Several major stakes races in England date from the 1700's. The oldest is the St. Leger Stakes, begun in 1776. The Oaks began in 1779, and the Epsom Derby in 1780. The St. Leger, Derby, and Two Thousand Guineas races form the English Triple Crown. Another important series of races is the Royal Ascot meeting, which the royal family traditionally attends. The three leading stakes races in the United States are the Kentucky Derby (first held in

WORLD BOOK diagram by Tak Murakami



A jockey's equipment includes a saddle, whip, boots, goggles, a safety helmet, and a jacket and cap. The jacket and cap, which are called *silks*, identify the horse's owner by their colors and by the arrangement of the colors. The horse wears blinders and an identification number.

1875), the Preakness (1873), and the Belmont Stakes (1867). These three races make up the American Triple Crown and are restricted to 3-year-old horses. Another important series of stakes races is the Breeders' Cup. Races are held in eight divisions. The main event is the Breeders' Cup Classic.

The Queen's Plate for Canadian 3-year-olds has been run every year since 1860. It is the oldest continuously run stakes race in North America. Other famous stakes races include the Prix de l'Arc de Triomphe in France, the Melbourne Cup in Australia, the Japan Cup in Tokyo, and the Dubai World Cup in Dubayy (also spelled Dubai), a state in the United Arab Emirates.

Claiming races are designed to bring together horses of equal ability. Any horse entered can be purchased at a fixed price by a licensed owner. The owner must make a bid, or *claim,* before the start of the race. Claiming races deter owners from entering a horse of high quality because it might be claimed by another owner.

Maiden races are held for horses who have never won a race. The quality of the horses varies. Some maiden races involve outstanding prospects beginning their racing careers at the age of 2. Other maiden events feature thoroughbreds with long losing streaks.

Allowance races. Generally, horses who win maiden races early in their careers advance to allowance races before entering stakes competition. Allowance races may match horses based on various conditions. Reductions in the amount of weight a horse has to carry are called *weight allowances.* These allowances are assigned based on the number or type of races won or previous earnings. Horses with fewer wins carry less weight. Allowance races are usually the best races on weekdays at major tracks, while stakes races top the weekend and holiday programs.

At the races

Almost all race courses in Europe have a grass surface, known as the *turf* in racing circles. Some races are run clockwise and others counterclockwise.

Thoroughbred races in North America generally are run in a counterclockwise direction. Most race distances vary from five furlongs to 1 $\frac{1}{2}$ miles (2.4 kilometers). A *furlong* is $\frac{1}{8}$ of a mile (0.2 kilometer). Most tracks consist of several layers of crushed rock, sand, and dirt. Most major race tracks also feature a grass course, which is separated from the main dirt course.

"They're off!" About 30 minutes before each race, the horses are brought from the barns to a saddling area called the *paddock.* The jockey meets the horse there. The trainer saddles the horse and gives the jockey instructions. The trainers hoist the jockeys into the saddle and the horses then walk onto the track for the *post parade* in front of the grandstand and clubhouse.

After a brief warmup, the horses enter their assigned stalls in the starting gate. Then an official known as the *starter* pushes a button, a bell sounds, and the starting gate doors open electronically.

At the track, officials called *stewards* supervise the racing. Following a race, there is a brief interlude. If no fouls are claimed or other irregularities reported, the stewards declare the race official. The betting payoffs are posted on an electronic display board called a *tote board* (short for *totalizator board)* in the infield area and on television monitors throughout the track.

Betting. A betting system called *bookmaking* is used in Australia, India, Ireland, South Africa, and the United Kingdom and in the U.S. state of Nevada. People called *bookmakers* set the odds and accept bets. The *parimutuel* system of betting, developed in France in the late 1800's, is also used. It is the only legal betting system in the rest of the United States and in such countries as Canada, France, and Japan. Under this system, bettors compete against one another. Odds are determined by the amounts wagered on each horse.

A horse favored to finish well attracts many bets and thus gets short odds, for example, 5 to 2. That means that, if the horse wins, a bettor wins $5 for every $2 bet, so the amount received by the bettor would come to $5 plus the original $2 bet ($7), minus a percentage that goes to the track (or bookmaker) and toward taxes. The heaviest-backed horse is called the *favorite.* A horse that bettors believe will not do well is called a *long shot* and will have bigger payoffs.

At U.S. tracks, a person wagers on a horse to win, *place* (finish second), or *show* (finish third). The holder of a win ticket collects only if the horse wins the race. A person with a place ticket wins if the horse finishes first or second. People with show tickets collect if the horse finishes first, second, or third. Usually, a win ticket pays the most money, and a show ticket pays the least. The odds plus the win, place, and show pools for each horse appear on the tote board and on TV monitors.

Special types of bets include the *daily double* and the *trifecta.* In the daily double, a person tries to select the winners of two specified consecutive races. In the trifecta, a bettor tries to pick the first-, second-, and third-place horses in a specified race.

For many years, most legal betting took place only at the race track. Beginning in the late 1900's, *off-track betting* (OTB) became popular. In many states, more money is wagered at OTB parlors than at the track. Another major development is *simulcast* betting—that is, televising races at one track to other tracks and off-track parlors for wagering. Simulcasts allow bettors to wager on races from tracks in many states.

Regulation. Thoroughbred racing is heavily regulated because of the gambling involved. The United Kingdom and many other countries have a dual regulatory system in which the Jockey Club and a government-appointed agency share responsibility for supervising racing. In the United States, state racing commissions appointed by the governors regulate the sport.

After the race, blood and urine tests are performed on the winners, defeated favorites, and randomly selected horses. The stewards can disqualify a horse and redistribute the purse money if tests reveal that the horse has been drugged, given an illegal medication, or given an overdose of a legal medication. However, winning bettors receive their money immediately after the race, and they do not lose if their horse is disqualified.

Before and after each race, jockeys are weighed with their saddles and certain other equipment. The weight must not be less than the weight assigned to the horse. The stewards can fine or suspend jockeys found guilty of fouls during a race. Stewards can also act against trainers whose horses have been drugged, given an illegal medication, or an overdose of a legal medication.

History

Horse racing may have begun shortly after horses were domesticated. Evidence suggests that chariot races were held in eastern Europe and northern Africa soon after the chariot was introduced in those regions about 1500 B.C. The Olympic Games in Greece first featured chariot races in 680 B.C. Races between horses with riders were added to the Olympic Games in 648 B.C.

The Romans, who controlled most of the island of Great Britain from the A.D. 40's to the early 400's, introduced horse racing there. The sport became an important part of English life, through the strong support of English monarchs and members of the nobility. As a result, horse racing is sometimes called the *sport of kings.*

King James I founded a racing center at Newmarket, England, in the early 1600's. King Charles II owned and rode race horses. Under his patronage, Newmarket became the birthplace of modern horse racing in the late 1600's and is the headquarters of British racing today.

English colonists who settled in America in the early 1600's brought horses and raced them. The first American track, called New Market, was founded in 1665 near what is now Belmont Park in New York. In 1791, the first volume of the *General Stud Book* was published in England, listing the pedigrees of over 350 mares. Each could be traced to Eclipse, Matchem, or Herod. The first volume of the *American Stud Book* was published in 1873.

Horse racing in the United States reached a peak of popularity in the 1890's. By 1897, there were 314 thoroughbred tracks throughout the country. Then a wave of opposition to gambling swept the country. The number of tracks declined to 25 in 1908. As of 1911, racing was outlawed in all but the states of Kentucky and Maryland.

Horse racing eventually made a comeback, particularly during the 1930's. The greatest American race horse of the era was Man o' War, winner of 20 of 21 races during a career that lasted just two years, 1919 and 1920.

The most accomplished English jockeys of the 1900's included Sir Gordon Richards and Lester Piggott. Richards was England's champion jockey 26 times between 1925 and 1953 and was the first jockey to be knighted. The leading American jockeys included Eddie Arcaro and Bill Shoemaker. Shoemaker ended his 42-year career in 1990 with 8,833 victories, a record that stood until Panamanian-born jockey Laffit Pincay, Jr., broke it in 1999. American jockey Steve Cauthen had great success both in the United States and Europe in the late 1900's.

In 1969, the American jockey Diane Crump became the first woman to ride in a pari-mutuel race at a major track. From 1981 until she retired in 1999, Julie Krone of the United States was a successful jockey, winning 3,545 races. In 2000, she became the first woman elected to the thoroughbred racing's Hall of Fame.

The greatest European race horses of the 1900's included Sea-Bird of France and Ribot of Italy. Among the greatest horses to train and race in the United Kingdom were Hyperion, Tudor Minstrel, Mill Reef, Brigadier General, and Nijinsky II. Nijinsky II won the English Triple Crown in 1970. Top Australian horses included Phar Lap and Tulloch, both bred in New Zealand, and Kingston Town. After Man o' War, the greatest American race horses included Citation, Secretariat, Seattle Slew, and Affirmed. All won the Triple Crown. In 1973, Secretariat ran perhaps the greatest race in history, winning the Belmont Stakes by a record 31 lengths and establishing a world record for the 1 $\frac{1}{2}$-mile distance on a dirt track. The dominant North American race horse of the 1990's was Cigar. He won 16 consecutive races to equal Citation's modern American record.

Neil Milbert

Related articles in *World Book* include:

Arcaro, Eddie	Grand National	Kentucky Derby
Francis, Dick	Hippodrome	Sande, Earl
Gambling	Horse	Shoemaker, Bill

Additional resources

Champions: The Lives, Times, and Past Performances of the 20th Century's Greatest Thoroughbreds. Daily Racing Form, 2000.

Morgan, Bert, and others. *Horse Racing: The Golden Age of the Track.* Chronicle, 2001.

Horsechestnut is the name of a group of trees and shrubs native to North America, Europe, and Asia. There are about 15 horsechestnut species. The most common one is the *European horsechestnut,* which first grew in the Balkans region in southeastern Europe. The European horsechestnut now is planted in much of the Northern Hemisphere for its shade and showy flowers.

Horsechestnut species native to North America are called *buckeyes.* Their large seeds look like the eye of a *buck* (male deer). The *Ohio buckeye* is a medium-sized shade tree found from the southern United States to Canada's Prairie Provinces. It is Ohio's state tree and the reason for Ohio's nickname, *The Buckeye State* (see **Ohio** [picture: State tree]). The *yellow buckeye* is common in parts of the central United States. The *red buckeye* is a shrub or small tree that grows in the southern states. The *California buckeye* grows chiefly on the West Coast.

The flowers of horsechestnuts range from white to rose and yellow. They open in clusters in late spring or summer. The leaves consist of five to nine leaflets

© Irvin L. Oakes, Photo Researchers

The European horsechestnut bears spikes of tiny flowers in May, as seen in this photo. Thick branches make it a good shade tree. Native American horsechestnut trees are called *buckeyes.*

© Leonard Lee Rue III, Earth Scenes
© L. L. T. Rhodes, Earth Scenes

The horsechestnut has dark green leaves and beautiful white flowers, making it a favorite for ornamental planting in parks and along streets. Horsechestnut seeds are large and brown. They are enclosed by spiny coverings, *right.*

attached at a common point. The seeds grow in large, leathery capsules and measure up to 2 inches (5 centimeters) in diameter. They are bitter-tasting and poisonous if eaten raw. However, American Indians once cooked the seeds for food.

Scientific classification. Horsechestnuts make up the genus *Aesculus* in the horsechestnut family, Hippocastanaceae. The European horsechestnut is *A. hippocastanum.* The Ohio buckeye is *A. glabra;* the yellow buckeye, *A. octandra;* the red buckeye, *A. pavia;* and the California buckeye, *A. californica.*

Harrison L. Flint

See also Tree (Familiar broadleaf and needleleaf trees [picture]).

Horsefly. See Horse fly.

Horsehair worm is a long, thin worm that looks like a coiled hair from the mane or tail of a horse. It is sometimes called a *hair snake* or *hairworm.* There are about 230 kinds of horsehair worms. Most of them live in the shallow water of lakes, ponds, and streams. They may grow as long as 3 feet (91 centimeters), but most are shorter. The majority of horsehair worms are black or brown.

Female horsehair worms lay thousands of eggs. A larva hatched from an egg forms a small, round structure called a *cyst.* The cyst may be eaten by a beetle, cricket, or grasshopper. The larva may then emerge from the cyst and penetrate beyond the insect's intestine. The young worm lives there as a parasite. The larva may also use a special organ to bore its way into the body of an insect. After the worm reaches maturity, it leaves the insect and lives freely in the water.

Scientific classification. Horsehair worms make up the phylum Nematomorpha.

Robert D. Barnes

Horseheal. See Elecampane.

Horsemanship. See Horse (How to ride).

Horsepower is a unit for measuring the power of an engine or motor in the customary system of measurement used in the United States. The term *horsepower* was first used by the inventor of the steam engine, Scottish engineer James Watt (see Watt, James). He used it to compare the power of steam engines to the power of horses. Today the term is used to measure the power of devices such as automobile engines, gas turbine engines, electric motors, and nuclear power plants.

Power is a measure of the rate of doing work. The amount of work to move one pound a distance of one foot is one *foot-pound.* One horsepower equals 550 foot-pounds of work per second, or 33,000 foot-pounds of work per minute. The *watt* is the unit for measuring power in the metric system. One horsepower equals 745.7 watts. See Foot-pound; Watt.

If an engine lifts a 550-pound object to a height of 2 feet in 1 second, it is working at a rate of 1,100 foot-pounds per second ($550 \times 2 \div 1 = 1{,}100$). This engine is delivering 2 horsepower ($1{,}100 \div 550 = 2$). If a person weighing 150 pounds climbs a height of 88 feet, he or she does 13,200 foot-pounds of work ($150 \times 88 = 13{,}200$). If the person makes the climb in 60 seconds, he or she is working at the rate of $\frac{4}{10}$ horsepower ($13{,}200 \div 60 = 220$; $220 \div 550 = \frac{4}{10}$). A person who is accustomed to hard work can work at a rate of between $\frac{1}{10}$ and $\frac{1}{8}$ horsepower continuously during an 8-hour day.

The power of an engine can be defined in several ways. Some of the most useful are (1) indicated horsepower, (2) brake horsepower, and (3) S.A.E. horsepower.

Indicated horsepower measures the power produced inside the cylinders of an engine. First, that power must be calculated by multiplying together the average pressure on the pistons, the area of each piston, the length of the piston's stroke, the number of power strokes per minute per piston, and the number of pistons in the engine. The indicated horsepower is determined by dividing the power by 33,000 foot-pounds per minute.

Brake horsepower is sometimes called *effective horsepower* because it is the amount of power available at the engine's output shaft. Brake horsepower is determined by the engine's speed and *torque,* the amount of twist exerted. A machine called a *dynamometer* measures brake horsepower. Brake horsepower is the rating most widely used by engineers. It is less than indicated horsepower due to friction and other power losses in the engine.

S.A.E. horsepower defines the power of an engine under specified conditions and allows valid comparisons between engines. This rating is approved by the Society of Automotive Engineers (S.A.E.). It is used in determining licensing fees for automobiles in some states.

Donald L. Stivender

See also Air conditioning (Capacity of air conditioners); Power (physics).

Horseradish is an herb whose root is used to make a sharp-food relish. The plant is native to Europe. It has many long leaves and a large root. People grate the root to prepare it for use. They preserve the grated pieces in vinegar to prevent loss of the chemical compound that gives horseradish its biting taste. The root retains its

WORLD BOOK illustration by John D. Dawson

The root of the horseradish has a biting taste.

sharp taste until it is ground. Whole roots retain their sharp taste for long periods.

When workers harvest horseradish, they remove the side roots. These roots are used for the following year's crop. Farmers cut the side roots for planting in the spring.

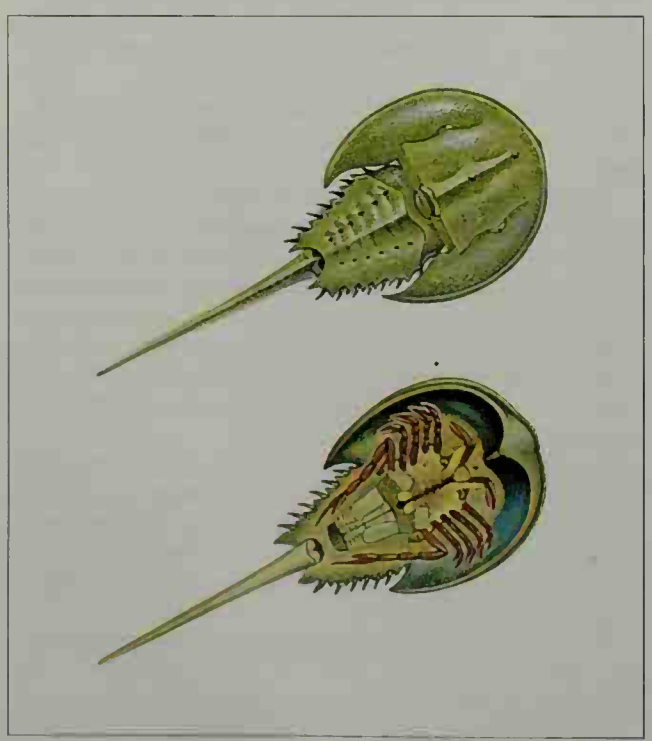
Scientific classification. Horseradish belongs to the mustard family, Cruciferae. It is *Armoracia rusticana.*

S. J. Locascio

Horseshoe. See Horse (Shoes); **Superstition** (Kinds of superstitions).

Horseshoe Bend, Battle of. See **Indian wars** (In the South); **Jackson, Andrew** (The Battle of Horseshoe Bend).

Horseshoe crab is a large marine animal with a shell shaped something like a horse's hoof. The horseshoe crab is sometimes called the *king crab.* However, it is not related to the commercially important *red king crab,* which is actually a crab. Horseshoe crabs are the only surviving members of a large group of animals that appeared on earth millions of years ago. The closest living relatives of horseshoe crabs are scorpions and spiders.



WORLD BOOK illustration by James Teason

The horseshoe crab has a shell that resembles a horse's hoof. The bottom illustration shows the underside of the animal. The crab has six pairs of legs. The front pair have pincers used to capture prey. The other legs are used for walking.

There are four species of horseshoe crabs. The largest grows to about 24 inches (61 centimeters) long and lives along the eastern coast of North America from Nova Scotia to the Yucatán Peninsula. The other three species inhabit the coastal waters of southeast Asia and the Philippines.

The horseshoe crab's body consists of two "hinged" parts, the *prosoma* and the abdomen. The prosoma is the part of the body covered by the shell and includes the head. The shell has openings for the animal's eyes. The mouth and legs are located beneath the shell on the lower surface of the prosoma. Horseshoe crabs have six pairs of legs. The front pair have pincers and are used to capture prey. The other five pairs of legs are used for walking.

The horseshoe crab's abdomen has six pairs of flattened, platelike structures. The reproductive organs are in the front pair of these plates. The remaining plates each carry approximately 150 soft gills by which the animal breathes. A jointed spine sticks out from the end of the abdomen. The horseshoe crab uses this "tail" as a lever for digging.

The horseshoe crab lives in marine coastal waters. It feeds at night on worms and small mollusks, such as clams, that it digs up from sand and mud. Horseshoe crabs mate in the spring. The female carries the male on her back to shore, where she digs several holes in the sand. The female lays from 200 to 1,000 eggs in each of the holes, and the male then fertilizes the eggs.

Scientific classification. Horseshoe crabs belong to the family Limulidae in the order Xiphosura. They are included in three genera: *Limulus, Tachypleus,* and *Carcinoscorpius.* The largest and most common species is *L. polyphemus.*

P. A. McLaughlin

Horseshoe Falls. See **Niagara Falls; Ontario** (picture: Horseshoe Falls).

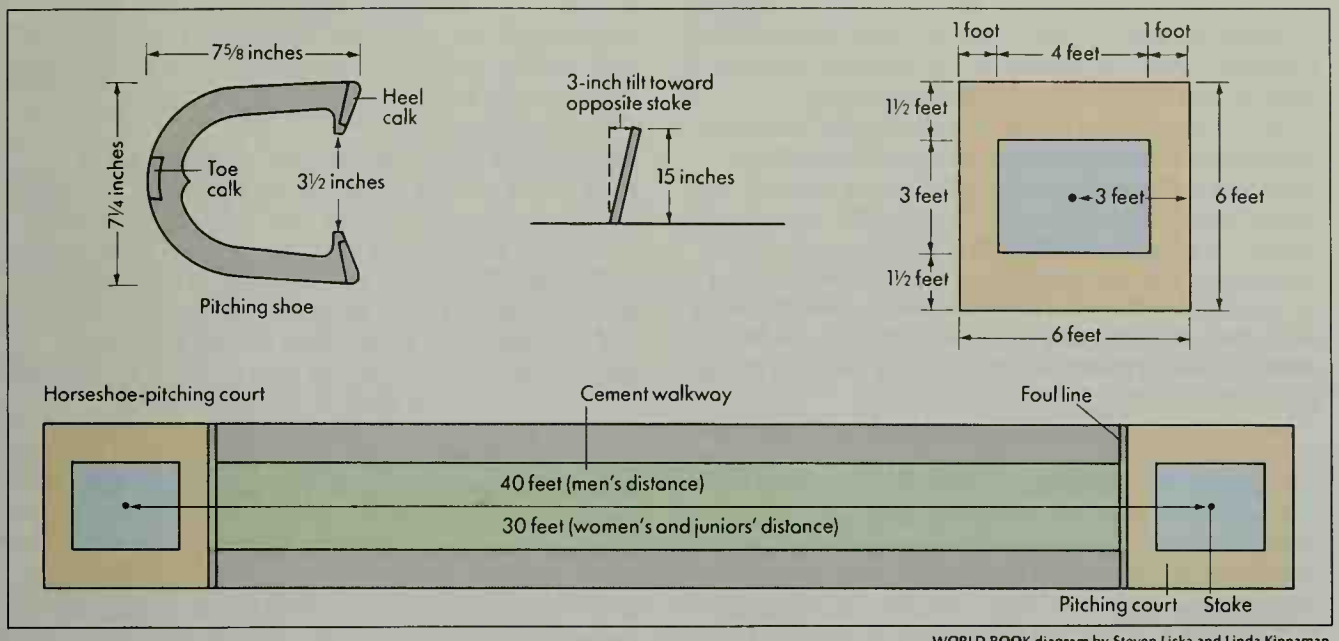
Horseshoe pitching is a game played by throwing horseshoes at a stake. Two, three, or four persons can play at a time. Players score points by getting the horseshoes close to or around the stake.

Rules. Regulation horseshoes are flat, U-shaped pieces of iron with a *calk* (small toe) at the closed end and at each tip. A shoe may not be more than $7\frac{1}{4}$ inches (18.4 centimeters) wide and $7\frac{5}{8}$ inches (19.4 centimeters) long. It must not weigh over 2 pounds 10 ounces (1.2 kilograms), and it must have no more than $3\frac{1}{2}$ inches (8.9 centimeters) of space between the calks at the open end.

A *pitching court* is about 6 feet (1.8 meters) wide and about 50 feet (15 meters) long. Within this area, two steel or iron stakes 1 inch (2.5 centimeters) in diameter are driven or anchored into the ground 40 feet (12 meters) apart. Each stake stands 15 inches (38 centimeters) high in a *pitching box* that is 6 feet (1.8 meters) square. Each pitching box has an area of clay, soil, or sand, in which the horseshoes land.

If two or three people play a game, they compete individually. If four play, two people make up each team. Players take turns throwing the horseshoes. A player throws two shoes each turn. Men pitch from a distance

Horseshoe pitching Horseshoe pitching is played on a rectangular court that has a stake set in a pitching box at each end. Players stand behind a foul line at one end of the court and pitch two horseshoes at the stake at the other end. The diagram below shows the dimensions of a regulation court and a horseshoe.



WORLD BOOK diagram by Steven Liska and Linda Kinnaman

of 40 feet from the stake. Women and juniors (players under age 17) throw from a distance of 30 feet (9 meters). Players pitch horseshoes with an underhand motion. Fingertip control gives the shoe a flip or turn so the open end faces the stake as the shoe lands.

Scoring. A *ringer* is a shoe that encircles the stake so that a straight edge can touch both tips of the shoe without touching the stake. A ringer scores 3 points. A shoe that comes to rest within 6 inches (15 centimeters) of the stake scores 1 point. A *leaner* (a shoe that leans against the stake) is also worth 1 point. There are two main systems of scoring horseshoe pitching contests, *cancellation* and *count-all*. In cancellation, a game usually consists of 40 points. If opposing players throw ringers or shoes that land equally close to the stake, the shoes cancel each other. Points are scored by counting the ringer or shoe closest to the stake that is not tied by the opposing player. A count-all game normally consists of *25 innings* (50 shoes thrown by each player). In a count-all game, all ringers and horseshoes within 6 inches of the stake are scored according to their point values.

History. Horseshoe pitching originated in Roman army camps about A.D. 100. The game has long been popular in the United States and Canada, but for many years it had no set rules. In 1914, a group of men set up standards of play and equipment, and the popularity of the game increased. The National Horseshoe Pitchers' Association of America, incorporated in 1920, developed from this group. The Canadian Horseshoe Pitching Association, now called Horseshoe Canada Association, was incorporated in 1929. Jack Adams

Horsetail is a plant with a hollow, jointed, and usually grooved stem. The stem contains silica, which is an abrasive material (see **Silica**). The horsetail is sometimes called *scouring rush* because it was once used to polish metal.

Most horsetails are small plants. The stalks of some species resemble tiny trees. In prehistoric times, some plants of this family grew to be large trees. The plant grows from perennial creeping rootstocks. It bears no flowers, and it is more closely related to ferns than to flowering plants. Horsetails reproduce by means of both spores and sex cells. The spores are contained in small cones at the tips of the stem or its branches, or sometimes on a separate stalk. The plant releases the spores, which germinate in damp places and grow into tiny plants. These plants produce male and female sex cells that unite and develop into mature horsetails.

WORLD BOOK illustration by Robert Hynes

Shoots of horsetail

Scientific classification. Horsetails make up the family Equisetaceae. They are genus *Equisetum*. Roy E. Gereau

See also **Plant** (Horsetails).

Horticulture, *HAWR tuh KUHL chuhr,* is a branch of agriculture that specializes in fruits, vegetables, flowers, and ornamental shrubs and trees. Horticulture includes the production, distribution, and processing of fruits and vegetables for food. It also involves the use of plants in landscaping and in such decorations as corsages and floral arrangements.

The word *horticulture* comes from the Latin word *hortus,* which means *garden,* and horticulture includes the art and science of gardening. Most horticultural crops were originally grown in gardens. Today, they are raised commercially on farms and in greenhouses, nurseries, and orchards.

Horticulture is widely practiced as an industry and as a hobby. The horticulture industry is the main source of fruits and vegetables, and an important supplier of plants raised for their beauty. Horticulturists in the floral, landscaping, and nursery industries raise plants for use in creating attractive surroundings. Horticultural hobbies include flower arranging and gardening.

Much horticultural research is conducted at agricultural experiment stations, arboretums, botanical gardens, and colleges and universities. Some research involves developing methods to improve the cultivation of plants. For example, horticultural scientists experiment to determine the environment and nutrition necessary for good plant growth. They also work to develop ways to control plant diseases and pests. Other research involves breeding plants to produce new varieties that are especially beautiful, hardy, or productive.

Horticulture is generally divided into four main specialties: (1) pomology, (2) olericulture, (3) floriculture, and (4) ornamental horticulture.

Pomology is the cultivation of shrubs, trees, vines, and other plants for their nuts or their sweet or tart fruits. Crops in this group include almonds, apples, coconuts, dates, grapes, oranges, peaches, and pecans.

Olericulture deals with *herbaceous* (nonwoody) plants raised for use as vegetables. Any part of a herbaceous plant may be the edible part. For example, asparagus is grown for its stem, and cauliflower for its flower buds.

Floriculture is the production and use of flowers and foliage plants. Floriculturists work mainly with house plants, flowers, and greenery for floral arrangements.

Ornamental horticulture is concerned with plants grown outdoors for landscaping. Such plants include shrubs; grasses for lawns; and maples, pines, and other ornamental trees. Ornamental horticulture also involves landscape design for homes, office buildings, highways, and recreational areas. Jules Janick

Related articles in *World Book* include:

Agricultural experiment station	Greenhouse
Arboretum	Herb
Botanical garden	Hotbed
Botany	Landscape architecture
Burbank, Luther	Nursery
Floriculture	Nut
Flower	Plant
Fruit	Tree
Gardening	Truck farming
	Vegetable

Horus, *HAWR uhs,* is the name for both the son of the Egyptian goddess Isis and of a number of ancient Egyptian sky gods. Horus the son of Isis was portrayed as a royal child, and the sky gods named Horus were shown as either falcons or falcon-headed men. The two types of Horus gods tended to be merged into a royal mythology surrounding the Egyptian pharaohs. These myths identified the pharaoh as both the earthly form of the royal falcon god who triumphs over his enemies and the pious son who claims the throne after the death of Osiris, his father. For an illustration of the sky god Horus, and a description of the role Horus the son of Isis played in the Osiris myth, see Mythology (Egyptian mythology).

The falcon god was worshiped under different names in various Egyptian communities, and distinctive myths developed around each of them. The eyes of Haroeris, also called the *great* or *elder Horus,* were the sun and moon. The Horus of Edfu, or *Behdety,* crossed the heavens each day as a winged sun disk. Harakhte, also known as *Horus of the two horizons,* was another sun god. The Egyptians later merged him with the sun god Re as the god Re-Harakhte. Orval Wintermute

See also Isis; Osiris.

Hosea, *hoh ZEE uh* or *hoh ZAY uh,* **Book of,** is a book of the Hebrew Bible, or Old Testament, named for an Israelite prophet. It deals with the prophet Hosea's ministry in the northern kingdom of Israel from about 745 to the 730's or 720's B.C., a period of great turmoil and uncertainty. Hosea witnessed the repeated killings and successions of kings. Many people worshiped pagan gods. Hosea regarded such worship as unfaithfulness to God and warned that evil would result.

Many scholars divide the Book of Hosea into two parts. The first describes Hosea's marriage as a symbol of God's relation with Israel. The second part tells the details and consequences of Israel's unfaithfulness to God, and promises God's love and blessings if it repents. Although Hosea shares many themes and ideas with other prophets, his use of symbolic names and the theme of marriage is unusual. His prophecy is also remarkable for its description of God as a loving father. Eric M. Meyers

Hosiery. See Stockings.

Hospice, *HAHS pihs,* is a family-centered concept of health care for people dying of an incurable illness. The hospice concept aims at easing the physical and psychological pain of the patient's illness, so that the person can appreciate his or her remaining life. It relies on a team approach to achieve this aim. The team includes the patient and his or her family, as well as physicians, nurses, social workers, members of the clergy, and volunteers. The modern system of hospice care began with the founding of St. Christopher's Hospice in London in 1967 by Cicely Saunders, an English physician.

The hospice concept emphasizes home care. Family members are encouraged to participate in caring for the patient when they desire to do so. The hospice staff works with the family and with community agencies to help the patient remain at home. Staff members visit the family regularly and are available at all times for emergencies. They try to provide what the patient and family need. Such hospice services may include nursing care and pain control, meal preparation, laundry, or shopping. Hospice staff members are also available to sit with the patient while family members rest. After the death of the patient, emotional support is provided for the family.

Hospice care is also available to *inpatients*—that is, patients who cannot remain at home. This care may be provided in a separate hospice medical center or in a hospice unit of a hospital. In some cases, a hospice team cares for patients throughout the wards of a general hospital. Inpatient hospice programs provide health care with a friendly attitude in a relaxed setting.

The word *hospice* also refers to a shelter for travelers, especially a refuge maintained by a monastery. The hospice of the Great St. Bernard became famous for rescuing people lost in the Swiss Alps (see Saint Bernard Passes). Sylvia A. Lack

Hospital is an institution that provides medical services for a community. The doctors, nurses, and other personnel of a hospital work to restore health to sick and injured people. They also try to prevent disease and maintain health in the community. Some hospitals serve as centers for medical education and research.

Every year, about 15 percent of the people of the United States spend some time as hospital patients. Millions of others visit hospitals as *outpatients.* They receive treatment but do not stay in the hospital.

The United States has about 6,700 hospitals and over 1,200,000 hospital beds. Most of the hospitals have fewer than 200 beds. About 500 hospitals have over 500 beds. In Canada, there are about 1,200 hospitals and about 180,000 beds.

Each state has laws that a hospital must follow to receive a license to operate. Most U.S. hospitals are also approved by the Joint Commission on Accreditation of Health Organizations. Accredited hospitals must meet basic national standards set by the commission. They must also undergo periodic inspections.

In the mid-1970's, the U.S. government set up *professional standards review organizations* (PSRO's). In 1984, groups of medical professionals called *peer review organizations* (PRO's) replaced PSRO's. These groups review the quality of hospital care given to patients covered by Medicare and other federal medical assistance programs. Some PRO's also review care paid for by businesses and private insurance companies.

Some form of institution for the care of the sick has existed longer than recorded history. The first centers for the ill were probably operated together with religious temples. Priests served as healers.

How hospitals are classified

Every hospital is classified according to (1) length of stay, (2) kinds of services, and (3) type of ownership.

Length of stay. Most hospitals are *short-term hospitals* in which the majority of patients stay less than 30 days. Patients spend an average of 4 to 8 days in a short-term hospital. In *long-term hospitals,* most patients stay more than 30 days. People having their tonsils removed would go to a short-term hospital. Those with severe mental illnesses may stay in a long-term institution because of the time needed to treat their condition.

Kinds of services. A *general hospital* provides services for most people and illnesses. A *special hospital* cares for certain people or certain illnesses. For example, *pediatric hospitals* treat only children. *Rehabilitation hospitals* provide services to help people adjust to mental and physical disabilities.

A hospital may perform other services besides treating the sick. For example, *research hospitals* conduct medical research. *Teaching hospitals* educate future physicians, nurses, laboratory specialists, and others planning a health-care career. A teaching hospital may form part of a university medical center, or it may be a general hospital associated with a medical school.

Type of ownership. Most hospitals are owned by their community. A board of trustees consisting of local residents manages such *community hospitals* in the public interest. A *nonprofit voluntary hospital* is owned by such organizations as charitable or religious groups. Community and nonprofit hospitals almost always spend more money for patient care than they receive in fees. Such hospitals must depend on donations to cover their costs.

A *private,* or *proprietary, hospital* is operated like a business to make a profit for the owners. Several corporations own chains of short-term general hospitals and psychiatric hospitals.

A *government hospital* is owned by the federal, state, or county or local government. The federal government operates hospitals that serve members of the armed forces and their dependents, veterans, American Indians, and certain other groups. Many state hospitals care for the mentally ill. Some county and local hospitals serve all the people in the area, especially the poor. Others offer special services, such as the treatment of contagious diseases.

Hospital departments and personnel

The professional services staff consists of the people directly concerned with the care of patients. The *medical staff,* made up of physicians, provides guidance to all other members of this team. Most physicians have an office practice and send their patients to the hospital when necessary. They then supervise the treatment.

In many hospitals, some physicians work directly for the institution and do not have a private practice. In some hospitals, many or all members of the medical staff work directly for the hospital. This arrangement occurs chiefly in government and university hospitals and in hospitals operated by labor unions or other groups for the benefit of their members.

The medical staff also includes physicians in training. These *residents* have graduated from medical school and work in a hospital for additional required experience.

The *nursing staff* forms the largest group on the patient care team. Professional nurses, generally called *registered nurses,* have graduated from a school of nursing operated by a hospital, university, or community college. They carry out much of the patients' care under the guidance of physicians. They also direct other members of the nursing staff, including *practical nurses, nurse's aides,* and *nurse attendants.* These men and women do many tasks to free the registered nurses for work requiring their special skills.

Professional services departments work with the physicians and nurses. The hospital *pharmacy* provides medicines that physicians order for patients. The *central service department* maintains medical supplies. The *food service department* prepares meals for patients and staff members. A dietitian directs this department and plans the menus. The dietitian also develops special diets for patients when ordered by a physician.

The hospital *laboratories* conduct tests that help doctors diagnose and treat illnesses. The *radiology department* makes X rays to help physicians diagnose diseases and injuries. Doctors also use X rays to treat cancer.

Many hospitals have a *rehabilitation department* that works with disabled patients to help them return to normal life. There are two basic types of rehabilitation therapy, *physical* and *occupational.* Physical therapy treats diseases or injuries. Occupational therapy helps overcome or reduce disabilities by teaching various skills. See **Occupational therapy; Physical therapy.**

The *medical records department* keeps a record on every patient. If former patients return to the hospital, their medical record helps the physician diagnose and treat their illness.

Administrative departments. Most hospitals have an administrator who is responsible for the operation of the entire institution. The board of trustees or the owner appoints this official. In some cases, a private management firm provides the administration of the hospital.

Various departments handle a hospital's business affairs. The *admitting office* schedules patients for admission at the request of their physician and assigns them to a room. The *business office* lists each patient's charges, prepares a bill, and records payments received. The *purchasing department* manages a hospital's stockroom and buys supplies and equipment.

A hospital maintains a *personnel department* to hire employees and handle employee relations. A large institution may have a *public relations office* to inform employees, patients, and the public about the hospital's operation. Some hospitals employ *patient representatives* to deal with patients' complaints.

The *volunteer services department* organizes the activities of a hospital's volunteers. These unpaid workers operate the coffee and gift shops in most hospitals. They also help raise funds for the institution.

Other employees also help a hospital run smoothly around the clock. Cooks prepare meals in the hospital kitchen. Housekeepers and janitors keep the institution clean to help prevent the spread of infection. Workers in the laundry department clean, sort, and press the hundreds of pounds of linens used daily. Such experts as electricians and engineers maintain a hospital's complex machinery. Security personnel protect hospital patients and property.

Hospital care

Hospital units. Most hospitals are divided into various units, each of which cares for certain groups of patients. The number of units varies according to the size and type of a hospital.

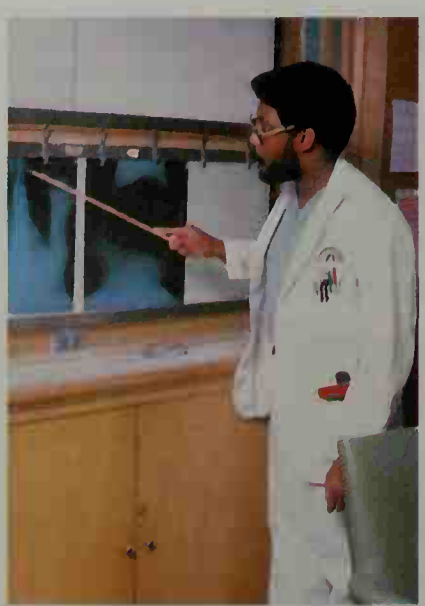
Most general hospitals have several basic units. For example, the *maternity unit* helps protect mothers and newborn babies from infection by keeping them apart from other patients. Except in extremely small hospitals, children stay in a *pediatric unit.* Some hospitals also have a *teen-age unit.* Men and women who do not require surgery stay in the *adult medical unit.*

Most hospital units are *intermediate care units,* in which the professional staff gives patients constant care and observation. *Intensive care units* serve critically ill patients. Some hospitals have *minimal care units* for patients who are well enough so that they or their families can provide much of the nursing care needed. A few institutions have *parent care units* for children. There, a parent stays with the child and provides all nursing care except technical treatments. In addition, a hospital may have a *psychiatric unit* for mentally ill patients, and units for burn victims, heart patients, premature babies, and others who require special care.

A hospital's *surgical unit* cares for patients awaiting surgery or recovering from an operation. Most hospitals have a *recovery unit* in which a patient who has received a general anesthetic can be watched closely after surgery. Many hospitals also have an *ambulatory surgical center* (ASC), or *same day surgery unit.* Patients usually go to the ASC in the morning and return home in the early evening. About 35 to 48 per cent of a hospital's surgical operations are performed in the ASC. These surgical procedures are usually uncomplicated ones, such as the removal of tonsils or the repair of knees and elbows.

A hospital also has an *emergency unit* that provides care for accident victims and people who have suddenly become ill. Since the early 1960's, services for outpatients have become a major function of the emergency unit. As a result, the use of emergency units has increased about 80 per cent. Less than a fifth of the pa-

David R. Frazier



Joan Menschenfreund, Taurus

David R. Frazier

A hospital provides many services to patients. In the emergency unit, *left,* accident victims receive immediate care. A radiologist, *center,* studies *radiographs* (X-ray pictures) to help diagnose illness. At mealtime, hospital workers bring trays of food to patients, *right.*

tients treated in emergency units actually have an urgent problem. They go to a hospital rather than a physician's office because the hospital provides care at any hour.

Nonmedical services. Hospitals provide many services not directly connected with a patient's medical needs. Relatives and friends may visit patients or talk with them by telephone. Many hospitals have lounges and sunrooms for patients who do not have to stay in bed. Hospitals furnish radios and television sets for patients, and many have lending libraries. Social workers and chaplains on the hospital staff try to help patients and their families solve personal problems.

Children have many special needs while hospitalized. Hospitals try to make pediatric units as pleasant as possible. These units provide playrooms and special activities for children. *Child life workers* give youngsters special attention and help them adjust to the hospital. Some hospitals arrange for children to visit the institution before being admitted. Some hospitals also let parents stay with their children and sleep in their room.

History

Early hospitals. The word *hospital* comes from the Latin word *hospitalis,* which means a *house* or *institution for guests.* As early as the 200's B.C., Buddhists had set up hospitals in India. Early in the Christian Era, hospitals were established for sick or weary travelers, and for the poor, the blind, and the crippled. Religious orders operated most of these early hospitals. For hundreds of years, hospitals chiefly cared for people who were too poor or too sick to be treated at home. Doctors did not work in the hospitals. They treated most patients in the patients' homes or in their own offices.

The oldest hospital still in existence is the Hôtel Dieu in Paris, founded during the A.D. 600's. The Spanish governor of Hispaniola built the first hospital in the Western Hemisphere in 1503. The ruins of the hospital still stand in Santo Domingo, Dominican Republic. The Spanish explorer Hernando Cortés founded a hospital in Mexico City that has existed since 1524. The first Canadian hospital opened in Quebec in 1639. The first incorporated hospital in the United States was the Pennsylvania Hospital. The hospital was established in Philadelphia with the assistance and support of Benjamin Franklin. The Pennsylvania Hospital, still in existence today, received its charter in 1751.

In the early 1700's, European cities and towns began to build hospitals. These hospitals served mainly the poor or the victims of contagious diseases. They operated as charity hospitals. The wealthy did not go to hospitals. They usually received medical care at home.

Early hospitals were dirty, crowded, and dark. The principles of sanitation were unknown. Diseases spread rapidly throughout hospitals because of lack of knowledge about the importance of cleanliness.

The 1800's. Medical discoveries in the 1800's helped begin the improvement of hospitals. In 1842, Crawford W. Long, a Georgia physician, became the first doctor to use ether as an anesthetic. Four years later, William T. G. Morton, a Boston dentist, arranged the first hospital operation using ether as an anesthetic. It was performed at the Massachusetts General Hospital in Boston.

During the late 1800's, doctors began to observe the principle of *antisepsis* (cleanliness to reduce infections). This principle made surgery much safer. It started the continuing trend of caring for patients in hospitals instead of at home. Doctors could not establish the necessary cleanliness at home. The use of X-ray equipment in hospitals began in the late 1890's.

Another feature of the late 1800's was the growth of hospital schools of nursing. Nursing schools in the United States were patterned after one founded in London by the famous English nurse Florence Nightingale (see **Nightingale, Florence**). The Massachusetts General Hospital, Bellevue Hospital in New York City, and the New Haven (Conn.) Hospital established the first American nursing schools in 1873. With trained nurses caring for the patients, standards of hospital care improved

Eric Kroll, Taurus

Martin M. Rotker, Taurus

Martin M. Rotker, Taurus

Special equipment helps hospitals care for patients. In an operating room, *left,* surgeons use laser beams to perform complicated procedures. Electronic equipment, *center,* lets nurses monitor patients' bodily functions. Incubators, *right,* help premature or sick babies survive.

very rapidly, and the number of patients increased.

Also in the 1800's, hospitals began to establish rooms for private patients. The idea of the charity hospital started to diminish. Patients began to pay for part of the cost of their hospitalization.

The 1900's. Many hospitals were built in the United States during the early 1900's. As the number of patients increased, the cost of hospital care rose because of the need for more equipment and personnel. Many people could not afford care, especially during the Great Depression of the 1930's. Hospitals often faced financial problems. The Blue Cross plan, developed in 1929, offered a form of prepayment insurance to help patients pay their hospital bills. During the 1930's and 1940's, more people purchased such insurance to protect themselves against the expense of hospitalization. Insurance helped put hospitals on a sounder financial basis because they could be sure of immediate payment.

Hospitals became overcrowded during the 1940's. To assist them, Congress passed the Hill-Burton Act in 1946. This law authorized government grants to help the states pay the cost of building new hospitals and enlarging and modernizing existing ones.

Recent developments. In the 1960's, hospitals became increasingly interested in serving the community. Many of them set up outpatient clinics that offered general family or pediatric care. A number of hospitals began to provide laboratory tests, X rays, and therapy for outpatients. Some hospitals set up neighborhood health clinics, and a few started programs in which staff members visit patients at home. Hospitals also sponsored programs to help people with such problems as alcoholism or narcotics addiction. In 1965, the United States government established Medicare, a program designed to help pay for the medical care of people age 65 and over. Another program, called Medicaid, was created at the same time to pay for the health care needs of poor people.

Many advances helped improve patient care. For example, surgical and intensive care units now use electronic equipment to keep a continuous record of a patient's blood pressure, heart rate, respiration, and temperature. Hospitals also use many disposable items for convenience and safety, including plastic thermometers and hypodermic syringes and steel needles.

During the 1970's, the services of many hospitals became available over a wide area as a result of regional planning. Under the direction of regional or community councils, several hospitals may cooperate with one another to avoid duplication of equipment and personnel. Small or rural hospitals without certain facilities may transfer some patients to regional hospital centers for special care. In some areas, for example, premature or sick infants are transferred to regional *newborn centers*. Specially equipped vehicles transport patients to regional hospital centers. Some states also have regional hospital centers that treat serious *trauma* (injury). Emergency vehicles, including helicopters, transport injured people to the nearest trauma center. These hospitals have specialized equipment, and many of their personnel are skilled in emergency lifesaving techniques.

During the 1980's, many people became concerned over the high cost of hospital care. The federal government developed a special program in which hospitals are paid fixed rates for treating specific diseases of Medicare patients. This system of payment is called DRG's (diagnostic-related groups). If the hospital bill exceeds the fixed payment, the hospital loses money. As a result, many hospitals have tried to better manage patient care. In the 1990's, Congress debated many proposals to improve the management of hospitals. See **Medicare; Medicine** (Providing medical care).

Career opportunities

A hospital offers a large variety of careers for people interested in helping the sick. Large institutions have

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Hospital care became widespread in cities throughout the United States during the early 1900's. Hospitals became an important part of public health care, particularly during outbreaks of disease, as standards of cleanliness and nursing improved. In this photograph, hospital patients are separated by sheets to prevent the spread of germs during the influenza epidemic of 1918-1919. A nurse wears a mask to prevent infection while treating a patient.

over 200 kinds of jobs. Many of these jobs may also be found in small hospitals. The training necessary for various hospital jobs differs widely. Many technical positions require a college degree, but other hospital careers involve on-the-job training. Carolyne Kahle Davis

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Hostage is a person held prisoner to force fulfillment of a demand. If the demand is not met, the hostage may be killed. The taking of hostages is illegal under both international law and the laws of individual nations. The physical mistreatment of hostages is also illegal but is considered a separate crime.

Most hostage taking occurs in connection with other crimes or as a result of political struggles. A bank robber, for example, may seize hostages and threaten to kill them unless the police allow him or her to escape. Hijackers of a ship or airplane may hold passengers and crew hostage to obtain such goals as a ransom payment or transportation to a safe destination. Kidnappers, too, sometimes hold their victims for ransom.

Hijackers and other terrorists often take hostages to demand a certain action by a government. In 1979, Iranian revolutionaries seized the U.S. Embassy in Tehran, Iran, and held a group of Americans hostage. The revolutionaries demanded that the deposed shah of Iran be returned to the country for trial in exchange for the hostages. The shah died in 1980, but the Americans were not released until 1981.

During times of war, countries have sometimes taken civilians as hostages. During World War II (1939-1945), for example, Germany sought to control underground resistance forces by taking hostages in France, Poland, and other occupied countries. Such hostage taking is illegal under international law. It is distinguished from the lawful action of taking enemy soldiers as prisoners of war.

In ancient and medieval times, nations often exchanged hostages to guarantee that both sides would carry out the terms of a treaty. The hostages, who were nobles or other important people, were treated as honored guests. But they could be executed if the treaty was broken. M. Cherif Bassiouni

See also Hijacking; Kidnapping; Political prisoner; Terrorism.

Hot line is a two-way communication system that links Washington, D.C., and Moscow. The hot line is officially known as the Direct Communications Link. It allows the president of the United States and the president of Russia to communicate directly and instantly when an international crisis arises. Its purpose is to reduce the risk of war caused by misunderstanding. Today, communication technology similar to that used for the U.S.-Russia hot line also connects other countries to one another.

The hot line was set up between the United States and the Soviet Union in 1963. It originally consisted of a wire telegraph circuit, teletype equipment at each end, and a radio telegraph circuit. The hot line was first used when fighting broke out between Israel and Arab nations in 1967. In 1978, a satellite communication system largely replaced the telegraph system. In 1991, after the Soviet Union broke up, the president of Russia replaced the Soviet leader at the eastern end of the hot line.

In 1999, the United States and Russia established the Situation and Crisis Center to allow better emergency communication. The center is in Moscow and has voice and video links to the U.S. Department of Energy's Emergency Operations Center. Arthur I. Cyr

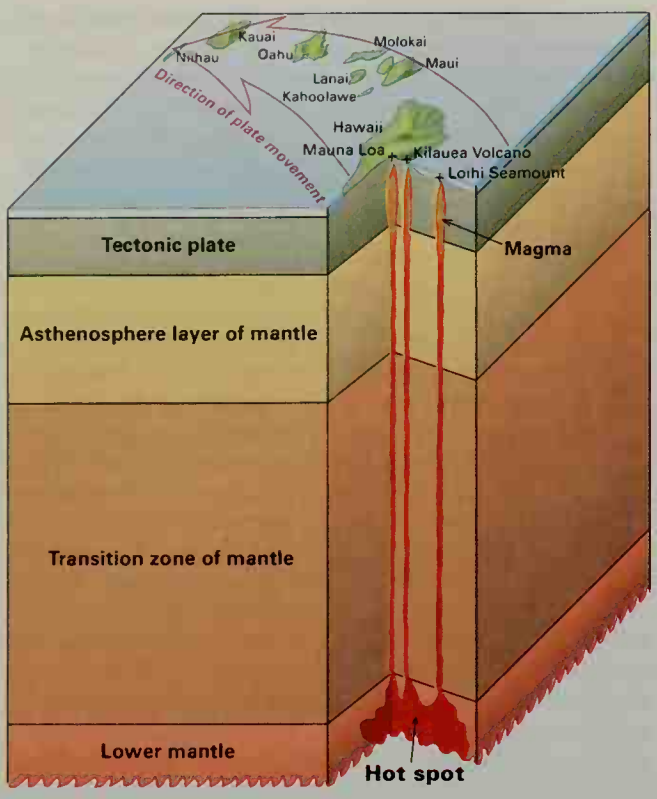
Hot rod is usually an older automobile with an improved engine or body design. Hot-rodders build their cars for either racing or normal driving. Hot rods built for driving often are referred to as *street rods.* Popular hot-rod models include Ford Model T's and Model A's and Chevrolets of the 1930's and 1940's. Hot-rodders seek to achieve the latest technology in brakes, steering, engines, and other parts to make the car run perfectly.

In the late 1940's, the National Hot Rod Association started hot-rodding as an automotive hobby. Hot rods then were stripped-down cars with fenders and hoods removed for streamlining. The cars were raced in supervised competitions in southern California. The sport soon spread throughout the United States. Hot rods run in races called *drag races* (see **Automobile racing** [Drag racing]). Critically reviewed by the National Hot Rod Association

Hot spot, also spelled *hotspot,* is an underground concentration of heat that creates volcanoes. The heat melts rock beneath the *crust,* Earth's outermost layer of rock. The melted rock, called *magma,* rises slowly to the surface, where it erupts as lava. Hot-spot volcanoes occur on land and in the ocean. In the ocean, they begin as submerged volcanoes known as *seamounts.* As they grow, some eventually rise above the water, becoming islands.

Volcanoes created by a single hot spot may occur along a line. For example, a hot spot under the Pacific Ocean generated a line of volcanoes that became the Hawaiian Islands. To visualize the formation of such a string of volcanoes, imagine lying on your back in a shallow stream of water and gently blowing air through a straw. Bubbles would form, rise to the surface, and flow downstream. The bubbles would represent the volcanoes.

Hot-spot volcanoes typically form a line because of the movement of *tectonic plates,* rigid pieces of Earth's outer shell. Each plate consists of crust and the upper of two layers of rock known as the *mantle.* The plates move constantly over the stationary lower layer of mantle, the *asthenosphere (uhs THEEN uh sfihr).* As a tectonic plate moves over a hot spot, the spot generates a chain of vol-



WORLD BOOK map

A hot spot under the Pacific Ocean created the Hawaiian Islands from hot rock that rose to the surface as magma and erupted as lava. The process of creation is still occurring. An undersea volcano called Loihi Seamount will one day become an island.

canoes. Many scientists believe that narrow, rising columns of hot mantle called *plumes* feed hot spots. The columns may originate at the base of the asthenosphere, near Earth's core.

Most of the largest hot spots have remained in place for more than 100 million years. However, not all hot spots appear to have a deep, long-lasting source. So hot spots may also form in other ways. Kenneth H. Rubin

See also **Plate tectonics; Seamount; Volcano** (How a volcano is formed).

Hot Springs, Arkansas (pop. 35,750), is the only city in the United States that has almost all of a national park within its city limits. The park is called Hot Springs National Park (see **Hot Springs National Park**). The city was named for the hot mineral springs located there. For location, see **Arkansas** (political map).

Millions of people visit Hot Springs each year. Thoroughbred horse races at Oaklawn Park race track attract many people. The city has many hotels, resorts, and other lodging facilities. Most of the people work in these facilities or in bathhouses or other tourist attractions.

A trapper, Manuel Prudhomme, founded the first permanent settlement at Hot Springs in 1807. In 1832, President Andrew Jackson signed a special act of Congress that named the town. The city grew rapidly after the Diamond Joe Railroad was completed in 1874, connecting Hot Springs with St. Louis, Missouri. Hot Springs has a city manager-board of directors form of government and is the seat of Garland County. M. Isabelle Peregrin

Hot springs are springs that discharge water heated by natural processes within the earth. Most hot springs are steadily flowing streams or calm pools of water. However, some are *fumaroles,* holes in the ground or vents that give off steam mixed with volcanic gases. Other hot springs are *geysers,* springs that throw up hot water with explosive force from time to time. Still other hot springs are bubbling pools of mud known as *mud volcanoes* or *mudpots.* Hot springs are also called *thermal springs.* See **Fumarole; Geyser.**

Hot springs originate when *surface water,* which results from rain and snow, seeps into the ground. Many springs occur in volcanic regions where hot molten rock called *magma* lies near the surface of the earth. Surface water trickles down through layers of rock until it is heated by the magma. Then the water rises to the surface through channels in the rock.

Hot springs also occur in regions that have *faults* (breaks) or *folds* (bends) in the layers of rock beneath the earth's surface. The temperature of the earth increases toward the interior. Faults and folds enable surface water to penetrate to depths where it is heated.

Many people believe that certain minerals found in some hot springs can relieve various ailments. Since ancient times, this belief has led people to bathe in the springs and to drink the water. Famous resort communities center around the hot springs in such places as Hot Springs National Park in the United States and Aachen, Baden-Baden, and Wiesbaden in Germany.

Most fumaroles occur in inactive volcanic regions, such as Yellowstone National Park. That park also has at least 200 active geysers and a mud volcano. Other mud volcanoes are located in New Zealand and Pakistan and on the island of Trinidad.

Hot springs are a source of *geothermal energy,* which is energy produced by underground steam or hot water. Several countries use geothermal energy to generate electric energy. The largest source of electric energy produced from geothermal energy is a generating facility at the Geysers steam field in northern California. Roy M. Breckenridge

See also **Baden-Baden; Hot Springs National Park; Mineral water; Wiesbaden; Yellowstone National Park.**

Hot Springs National Park is a health and pleasure resort in the Ouachita Mountains of Arkansas. It is nearly surrounded by the city of Hot Springs (see **Arkansas** [physical map]). The park is built around the famous hot mineral springs at the base of Hot Springs Mountain. These mineral waters are said to give relief to people suffering from many painful diseases, such as arthritis, neuritis, and rheumatism. The water has an average temperature of about 143 °F (62 °C).

Bathhouses in Hot Springs National Park operate under rules set up by the United States Department of the Interior. Eight of the bathhouses form what is called Bathhouse Row at the base of Hot Springs Mountain. The National Park Service maintains a water collection and distribution system that supplies purified spring water to the bathhouses in the park. Indians were the first to use the beneficial spring waters. The region, containing 47 hot springs, was set aside as a federal reservation in 1832. It was the first national health and recreation center in the United States. It became a national park in 1921. For its area, see **National Park System** (table: National parks). Critically reviewed by the National Park Service

See also **Arkansas** (Springs); **Mineral water.**

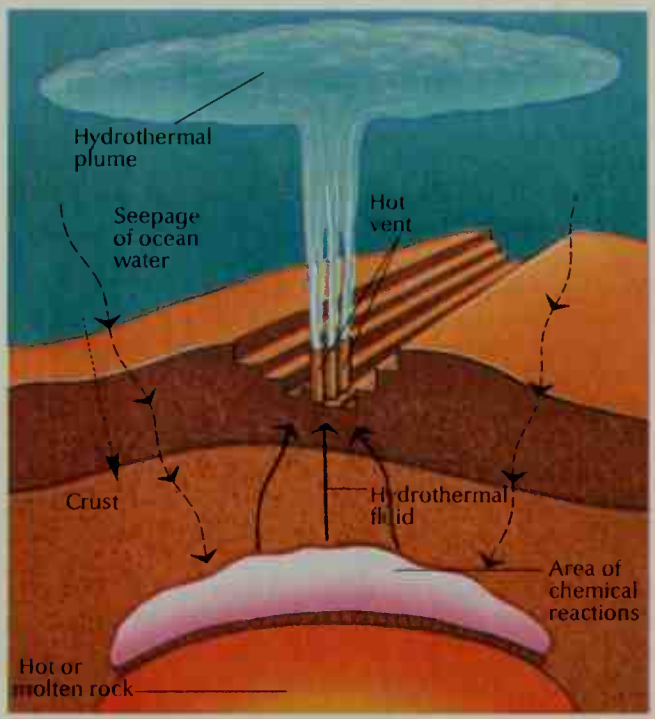
Woods Hole Oceanographic Institution

A hot vent discharges hot, mineral-rich fluid into the ocean. Metal sulfides in the fluid blacken it, giving it the appearance of smoke. The fluid is also rich in hydrogen sulfide gas.

Hot vent formation

Hot vents result from a seepage of water into heated oceanic crust. Chemical reactions produce a mineral-rich fluid, which rises. Particles settle out of the fluid, building up the vent structure.

WORLD BOOK diagram by Paul D. Turnbaugh



Hot vent, or *hydrothermal vent,* is a chimneylike structure on the ocean floor that discharges hot, mineral-rich water. Scientists first observed hot vents in 1977, in the Galapagos Rift, a region on the floor of the Pacific Ocean approximately 600 miles (1,000 kilometers) west of Ecuador.

Hot vents result from a process called *hydrothermal circulation.* A heat source within the earth, such as hot or molten rock beneath a volcano, supplies energy for this process. Seawater seeps down into the sea floor and, as it descends, becomes hot. It reacts chemically with the rocks through which it passes, changing to an acidic fluid that is rich in dissolved metals and hydrogen sulfide gas. This hot fluid then rises to the sea floor and discharges into the ocean at temperatures up to 750 °F (400 °C).

As the hot fluid mixes with the cold seawater, particles of metal sulfide form. The particles make the water

National Park Service

Hot Springs National Park is built around the famous mineral springs of Hot Springs, Arkansas. This illustration shows the bathhouses on Central Avenue in the late 1800's. Hot Springs was a popular destination for people who believed that the water from the springs could relieve such painful diseases as arthritis and rheumatism.

black, so hot vents are sometimes called *black smokers.* The metal sulfides settle out, forming chimneylike structures and creating mineral deposits rich in iron, copper, and zinc.

Hydrothermal vent sites are oases of life that are inhabited by unusual creatures. At Pacific Ocean hot vents, large worms up to 10 feet (3 meters) long and clams and mussels up to 1 foot (30 centimeters) in diameter are common. At Atlantic Ocean hot vents, shrimp, smaller mussels, and flower-shaped animals called *sea anemones* dominate. Life around hot vents is based on a process known as *chemosynthesis.* The lowest creatures on the food chain are microscopic organisms that live on hydrogen sulfide and other chemicals. Most of the other creatures eat the microorganisms or feed on the nutrients produced by them. Susan E. Humphris

See also **Archaea; Deep sea; Ocean** (The land at the bottom of the sea).

Hotbed is a low, heated enclosure in which plants are grown during cold weather. Gardeners use hotbeds in spring to sprout seeds before the growing season. In addition, hotbeds protect plants from cold in fall and winter.

A hotbed consists of a four-sided wood or concrete frame built on the ground and covered by glass or transparent plastic. The cover is slanted to allow the maximum amount of sunlight to enter and help warm the growing area. Most of the warmth comes from electric heating cables, which are located under the soil and controlled by thermostats. In large hotbeds, such as those used by professional gardeners, the heat comes from pipes that surround the growing area or are buried in the soil. A furnace sends steam, hot water, or hot air through the pipes to heat the frame.

Gardeners once heated hotbeds by burying a thick layer of manure under the soil. As the manure decayed, it produced heat and fertilized the soil. A structure similar to a hotbed but heated only by sunlight is called a *cold frame* (see **Cold frame**). William H. Carlson

See also **Greenhouse.**

Hotel is an establishment that provides overnight lodging for the public. Its basic service is providing a room to sleep in. But most hotels also have at least one restaurant. Many hotels offer rooms and services for meetings, and some have shops and offer entertainment.

Hotels range in size from large buildings with over 3,000 rooms to small inns that have as few as 8 to 10 rooms. Small hotels do not offer the range of services provided by large establishments. However, rooms and meals at most small inns cost less than those at large hotels.

Hotels in North America employ about one staff member for every two rooms. The hotel staff works around the clock to make the guests comfortable. The housekeeping staff cleans each room daily. Bellhops carry luggage and packages to the guests' rooms. The engineering department keeps the hotel's electric wiring, plumbing, heat, and air conditioning in good working order. The hotel security department works to prevent fire, theft, and other disturbances.

Some hotel restaurants provide *room service,* by which guests can have food and beverages brought to their rooms. In certain hotels, guests also can have clothing laundered by the hotel's *valet service.*

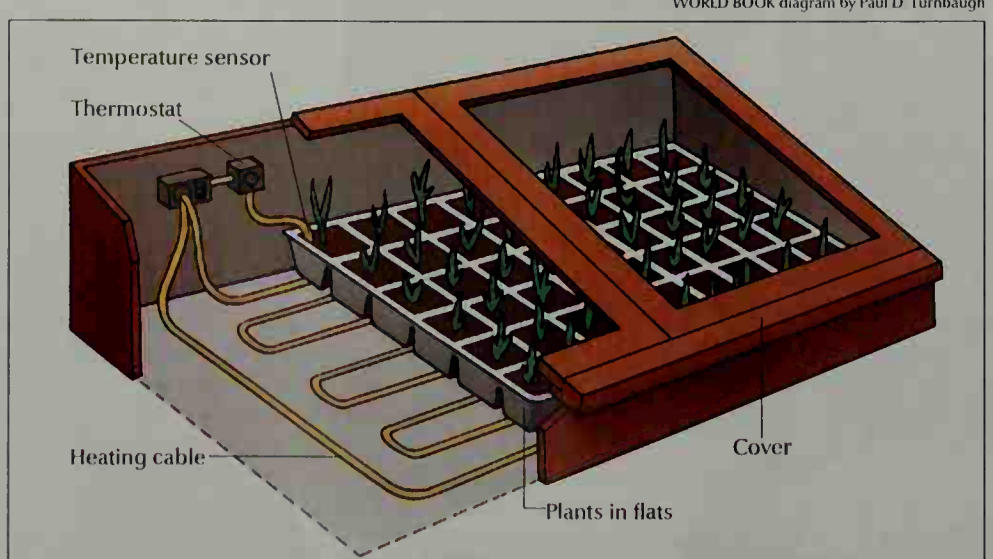
Motels differ from hotels in that they are designed specifically to serve automobile travelers. Most hotels occupy one multistory building that has a central lobby on the main floor. Guests reach their rooms through the lobby. Motels may consist of one or more buildings and always include a parking lot. Guests can enter their rooms directly from the lot. Many lodging operations offer both full hotel services and parking.

Kinds of hotels. There are three chief kinds of hotels: (1) commercial hotels, (2) resort hotels, and (3) residential hotels.

Commercial hotels. Most commercial hotels are near the airport or the downtown area of a large or medium-sized city. These hotels serve mainly business travelers and others on short trips. Many commercial hotels provide luxurious surroundings and numerous services.

The guests in most commercial hotels have a choice of restaurants, ranging from coffee shops to elegant dining rooms. Some of these restaurants offer music, dancing, and other entertainment. Shops in commercial hotels include clothing stores, gift shops, and newsstands. Some hotels have barber shops and beauty salons, and

WORLD BOOK diagram by Paul D. Turnbaugh



A hotbed protects plants grown during cold weather. The electric hotbed shown at the left has heating cables lying under *flats* (trays) that contain the plants and soil. A thermostat controls the temperature. The slanted, transparent cover lets in sunlight and helps keep the enclosure warm.

many have swimming pools and health spas. Most commercial hotels have a European plan of payment, which covers only the price of a room.

Many commercial hotels have large rooms that their guests and other groups can use for banquets, conventions, and meetings. The hotel's catering department provides meals and snacks for such events.

Resort hotels feature golf, skiing, swimming, and other outdoor activities that attract vacationers. The guests at these establishments stay from a weekend to several weeks. Most resort hotels are near lakes, mountains, or oceans. But many stand within easy reach of large cities and serve as vacation spots for nearby residents. Some operate in conjunction with gambling casinos.

Business is seasonal at most resort hotels. During the winter months, for example, large numbers of people travel to seaside and mountain resorts in tropical areas or go to ski lodges. Many resort hotels use the *American plan* of payment, which covers lodging and meals.

Resort hotels also provide indoor activities for their guests. Many have bowling alleys, game rooms, and indoor swimming pools and tennis courts. Some resort hotels feature dancing, music, and other entertainment.

Residential hotels rent one or more rooms for long periods of time. These hotels resemble apartment buildings but also offer meals and maid and valet service. Some residential hotels have small apartments with kitchenettes. Residential hotels called *retirement hotels* specialize in lodgings for senior citizens. Retirement hotels offer medical care as well as regular hotel services.

History. The earliest inns were established about 3000 B.C. Most of them were private homes whose owners provided rooms for travelers. Many early innkeepers did not keep the rooms clean, and they provided only crude meals for their guests. Several travelers usually had to share the same room and sometimes even the same bed. The quality of inns, especially of those in England, improved during the A.D. 1700's, when more people began to travel for pleasure.

The first building in the United States constructed specifically as a hotel was the City Hotel, which opened in New York City in 1794. During the 1800's, only the wealthy could afford to stay at European hotels. In the United States, however, many hotels offered comfortable, inexpensive lodgings.

Early hotels had many beds, no locks on room doors, and no lobbies. Guests usually entered a hotel through a bar. In 1829, the Tremont House in Boston became the first hotel to provide private rooms with locks. The Tremont also was the first hotel to have a lobby and to offer indoor plumbing.

Hotels expanded their services in the early 1900's. During that period, Ellsworth M. Statler, an American hotel operator, opened hotels that included many new features. For example, Statler's hotels provided private baths and full-length mirrors in each room.

Hotels have long been built near transportation centers. In the 1800's and early 1900's, when most people traveled by train, many hotels stood near railway stations. A great increase in automobile travel during the 1940's and 1950's led to the development of motels, many of which stand near major highways. Today, because many business people travel by airplane, many new hotels are built in city centers and near airports.

During the mid-1900's, numerous hotels owned by one person or company were built in cities throughout the United States. These hotels make up *hotel chains,* which can operate more efficiently and at less expense than most independent hotels. All hotels in a chain function the same way and use the same name. Some chains operate hotels in many countries.

Some hotel chains use the *franchise system.* In this system, a person or company buys the right to own and operate a hotel in the chain. The owner also pays the chain part of the hotel's income in return for use of the chain's well-known name and reputation.

In the 1980's, the lodging industry introduced *all-suite hotels.* Guests in these hotels may use a bedroom, a living room, and a small kitchen for about the price of a single room elsewhere. The room rate may include breakfast and cocktails. Glenn Withiam

See also Hilton, Conrad N.; Motel; Youth hostel.

Hotel Employees and Restaurant Employees International Union represents men and women employed in the public feeding and lodging industry. Members work at construction, logging, and mining camps; in factory cafeterias; in airport flight kitchens; on railroad dining cars; and in motels, hotels, restaurants, and bars. The union has locals in all parts of the United States and Canada. It is affiliated with the American Federation of Labor-Congress of Industrial Organizations and with the Canadian Labour Congress. For membership, see **Labor movement** (table).

Delegates from cooks' and waiters' unions organized the union in 1891. Membership in the union declined sharply during the 1920's, but grew rapidly with the later organization of unskilled hotel workers. The union has headquarters in Washington, D.C. Critically reviewed by the Hotel Employees and Restaurant Employees International Union

Hothouse. See **Greenhouse; Hotbed.**

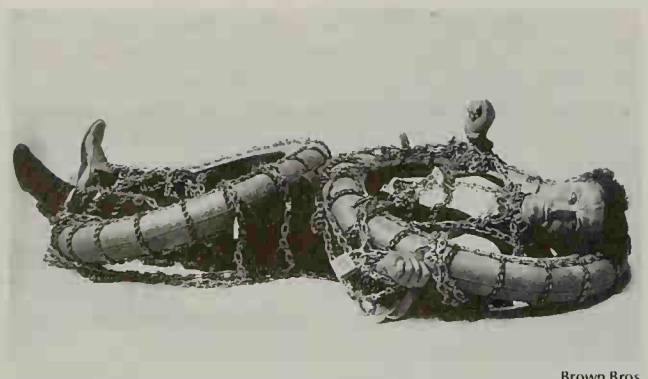
Hottentot. See **Khoikhoi.**

Houdini, *hoo DEE nee,* **Harry** (1874-1926), was an American magician who won fame throughout the world as an escape artist. Houdini could quickly free himself from apparently escapeproof devices, including leg irons, 10 pairs of handcuffs, jail cells, and nailed crates. His most sensational feat consisted of escaping from an airtight tank that was filled with water.

Houdini performed many publicity stunts to stimulate interest in his act. For example, he let himself be tied in a straitjacket and hung upside down from the eaves of a tall building. He struggled free in a few minutes. Houdini also became known for criticizing spiritualist mediums, who claimed they could communicate with the spirits of the dead. He believed that mediums deceived the public, and he copied their feats to show they were frauds. Houdini starred in several motion pictures.

Houdini was born on March 24, 1874, in Budapest, Hungary. His family moved to Appleton, Wisconsin, when he was a child. He later claimed he was born in Appleton. Houdini's given and family name was Ehrich Weiss. He took his stage name from Jean Eugène Robert-Houdin, a French magician of the 1800's. He later made it his legal name.

Houdini began his career performing card tricks in a dime museum. By 1900, after developing his escape act, he became a headliner and starred in many leading theaters throughout the world. Houdini's show featured



Brown Bros.

Harry Houdini, one of America's greatest magicians, became world famous for his ability to escape from almost any form of restraint, from chains and handcuffs to federal prison cells.

magic tricks, escapes, and demonstrations of what he regarded as spiritualist fraud. Don B. Wilmeth

See also Magician (picture).

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Houdon, *oo DAWN,* **Jean Antoine,** *zhahn ahn TWAN* (1741-1828), was probably the greatest French sculptor of the 1700's. Many critics rate him as the leading European sculptor of his time. As a portrait sculptor, he recorded the images of many great men and women both in Europe and the United States. Houdon's ability to capture the character of his subjects inspired many later sculptors. Houdon sculpted in plaster, terra cotta (a type of clay), marble, and bronze. His control in working his materials has seldom been equaled.

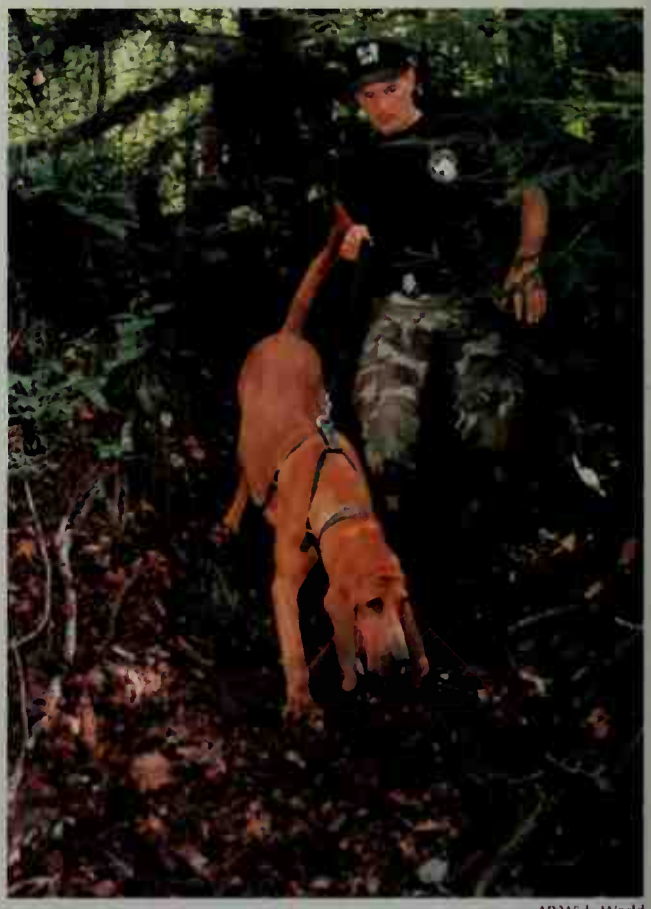
Houdon was the first major European sculptor to visit North America. He traveled to the United States in 1785 to model a portrait of George Washington. His full-length portrait of Washington (1791), which stands in Virginia's Capitol in Richmond, has been called the best likeness of the president ever made (see **Virginia** [Interesting facts]). He also sculpted busts of Thomas Jefferson, Benjamin Franklin, Admiral John Paul Jones, and inventor Robert Fulton. These portraits are among the most impressive artistic documents left from the early years of the American republic.

Houdon was born on March 20, 1741, in Versailles. From 1764 to 1768, he attended the French Academy in Rome, where he studied the major artworks of ancient Rome. In addition to portraits, Houdon occasionally sculpted mythological and religious subjects. Some of these works are informal and intimate. Others are grand in scale and concept. Douglas K. S. Hyland

Hound is the name of a group of dogs. Hounds are of two types: those that hunt by following the scent of their quarry, and those that hunt by sight. Scent hounds include the foxhound, black and tan coonhound, beagle,

Marble sculpture (1788) State Capitol, Commonwealth of Virginia from the Library of Virginia

A Houdon statue of George Washington stands in the rotunda of the Virginia State Capitol. Houdon completed the life sized marble statue of Washington in his military uniform in 1788.



AP/Wide World

The bloodhound has a keen sense of smell that enables it to follow a trail several hours old. This bloodhound is helping law enforcement officials track down a criminal suspect.

bloodhound, basset hound, dachshund, and petit basset griffon vendéen. Among sight hounds are the greyhound, Afghan, borzoi, Scottish deerhound, Saluki, and Irish wolfhound. The typical hound has long ears, strong legs, and a long tail. Hounds are alert, love the outdoors, and have great endurance. They are among the oldest known dogs. For additional information on hounds, see **Dog** (Hounds; picture: Hounds; table).

Critically reviewed by the American Kennel Club

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Beagle	Ibizan hound	Scottish deerhound
Black and tan coonhound	Irish wolfhound	Whippet
Bloodhound	Norwegian elkhound	
Borzoi	Otter hound	

Houphouët-Boigny, *oo FWAY bwah NYEE,* **Félix,** *fay LEEKS* (1905-1993), served as president of Ivory Coast from 1960 until his death in 1993. He became the country's first president in 1960, when it gained independence from France. As president, Houphouët-Boigny helped unite the country's many ethnic groups. He maintained close relations with France and other Western European nations. Ivory Coast received much economic support from those nations. Under Houphouët-Boigny, Ivory Coast achieved political stability and much economic progress. However, economic problems helped cause some political instability in the early 1990's.

Houphouët-Boigny was born in Yamoussoukro, near Dimbokro, Ivory Coast. He practiced medicine for many years before entering politics in the mid-1940's. He served in the French government from 1945 to 1959. He helped bring independence to Ivory Coast and other French-controlled African areas. Mark W. DeLancey

Hour is an interval of time. It consists of 60 minutes. A day, from midnight to midnight, has 24 hours. Every nation regulates its activities according to the hour. But people did not begin to use hours to mark uniform periods of a day until the 1300's, when the mechanical clock was invented.

The ancient Romans used the hour to note a point of time, such as sunrise and sunset. They later added the hour of noon. At the beginning of the Christian era, the Romans divided the hours of daylight into five periods, which they marked on their sundials. In A.D. 605, the Christian church named the *seven canonical hours,* or hours of prayer. They were (1) *matins* (morning) and *lauds* (praise), (2) *prime* (first), (3) *tierce* (third), (4) *sext* (sixth), (5) *nones* (ninth), (6) *vespers* (evening), and (7) *complin* (complete). These hours marked only periods of daylight, beginning at 6 a.m. The nights were sometimes divided into *watches,* which marked the times when guards reported for duty or were changed. The length of the hour varied with the season. The winter hours were shorter than the summer hours, because there was less daylight during the winter.

By the 1500's, many churches and palaces in Europe had installed mechanical clocks with 12-hour dials. These clocks did not keep good time, and they had to be set every sunshiny day at noon, when the sun was at its highest point, or *on the meridian.* From this we get the letters a.m., meaning *ante* (before) *meridiem,* or before noon; p.m. means *post* (after) *meridiem,* or after noon. When people first began to tell time by the clock, they substituted the word *o'clock,* meaning by the clock, for the word *hour.*

Confusion can result if the letters a.m. and p.m. are not used. European railroads and airplane timetables use a single 24-hour system. To avoid confusion, four figures are used. Thus, 1:00 a.m. is written 01:00. 1:00 p.m. is written as 13:00, and 12:00 midnight is 24:00. The United States armed forces also use this system, but without the colon. In conversation, all four figures are used, such as "O one hundred" for 1:00 a.m., "twelve hundred" for 12:00 noon, and "twenty-four hundred" for 12:00 midnight. James Jespersen

See also **Clock; Day; Time.**

Hourglass is a device that measures time. It has two glass bulbs joined together by a small opening. One of the bulbs contains grains of fine, dry sand. The sand takes exactly one hour to drain from the top bulb to the bottom bulb. When all the sand has run from the top bulb, the hourglass is turned over, and the sand begins to run into the empty bulb as before. Some earlier hourglasses contained mercury, but sand works better because it flows at an even rate, regardless of the amount the bulb contains. An hourglass that contains sand may be called a *sandglass.*

Smaller glasses, such as the *half-hour glass,* measure shorter periods of time. Even smaller glasses measure the time needed to boil eggs. These are called *egg glasses.* For many years, hourglasses were used to limit the amount of time a speaker could talk. Until the 1900's, sailors used a device like an hourglass that measured less than a minute while the log line was allowed to run out. In this way, they could determine how fast the ship was traveling. Hourglasses were widely used before the invention of mechanical timepieces. However, they have been replaced by watches and clocks. Many writers have mentioned the hourglass to express the passage of time.

David R. Frazier

The hourglass was used to measure time before clocks were invented.

James Jespersen

Housatonic River, *HOO suh TAHN ihk,* is an important waterway of New England. The river is 148 miles (238 kilometers) long. It rises in the Berkshire Hills in Massachusetts, flows southward through Connecticut, and enters Long Island Sound about 4 miles (6 kilometers) east of Bridgeport. Hydroelectric plants along the river are an important source of electrical power. The wooded shores of the river are noted for their great scenic beauty. Many people enjoy fishing for trout and salmon in the Housatonic. John L. Allen

House is a building that provides shelter, comfort, and protection for its inhabitants. Houses range in size from small cottages to huge mansions. Many rise two or more floors, and others spread in long, low lines across the ground. Houses vary greatly in appearance, depending on when and where they were built and what building materials were used.

Building materials

Houses are often classified according to the chief type of building material used. For example, we speak of *frame* (wood) houses; brick houses; and stone houses. A combination of materials may also be used. For example, a thin layer of brick or stone called *veneer* may be applied over wood. *Prefabricated* houses are built with factory-made sections assembled at the building site. *Manufactured* houses are built completely in factories and moved to the homesite. The kind of materials used in the construction of a house depends mainly on the size of the house, its location, its design, and the climate.

Wood has long been a popular building material because it is usually more plentiful and cheaper than other materials. Houses are often made of fir, pine, hemlock, redwood, and spruce. Redwood and cedar often are used for the *siding* (outer covering), if the siding is not going to be painted. Other woods, including oak, cypress, maple, walnut, and birch, are used for such interior features as stairways, cabinets, floors, and doors.

Brick is one of the oldest and most common building materials. Brick wears well and, like wood, is usually easy to obtain. Builders often use brick when building codes require a more fire-resistant material than wood—for example, in the construction of row houses. Bricks are available in a number of colors and finishes.

Concrete block and stone make strong, attractive houses that are relatively cheap to maintain. Concrete blocks are made by pouring a mixture of cement, sand, water, and other materials into a mold. Builders also make houses of stone that has been taken from quarries and split into usable sizes. Because stone is an expensive building material, it is usually applied as a veneer over an inner wall of brick or concrete block.

Other materials. Builders often cover a house's exterior with aluminum or vinyl siding. These types of siding provide insulation, prevent rotting, and save much repainting and repairing. Window frames may be made of aluminum or vinyl, or wood clad with aluminum or vinyl for protection against the weather. Manufacturers coat nails for use in home construction with zinc, copper, nickel, or aluminum to make them rustproof.

Building a house

A person building a house must first select a *lot* (piece of land). The next step is to consult an architect or builder. This expert will check local zoning laws and electrical, building, and plumbing codes. Knowledge of these codes protects the homeowner in both the present and the future. For example, the building code in an area may specify how deep the foundation must be, based on soil conditions and the depth to which the ground freezes.

The architect then designs the house according to the owner's ideas and budget. The architect must also consider the size and shape of the lot and the location of the house on the lot. The architect prepares construction drawings, which provide information on the size of the house and details of how it is to be built. These drawings are the basis of the contract between the builder and the homeowner. The architect also prepares *specifications,* a written description of the house materials. The drawings and specifications are used to determine the cost of the house and to obtain a *building permit* from the community.

The following sections describe the steps involved in building a typical frame house.

The foundation supports the house. First construction workers begin *excavating* (digging) holes or trenches for the *footings,* the lowest part of the foundation. The footings support each wall load. They are made by pouring concrete into wood or steel forms that workers place below the *frostline,* the depth to which the ground freezes. This is done so that the footings will not freeze and shift. Builders generally use concrete or concrete block for the house's foundation. The foundation walls rest on the footings. These walls rise from 8 inches to 3 feet (20 to 90 centimeters) above the ground.

An area within the foundation below the first story is called a *basement.* Basements add to the cost of building a house, but they provide extra room. Many basements have separate rooms for the home's heating unit and laundry equipment, and for storage. Some basements also have a recreation room.

Most of the houses built today do not have basements. In many low or damp regions, houses are raised above the ground on concrete *piers* (supports). Sometimes a *slab* foundation is laid directly on the ground, especially if the earth beneath the house is hard. The ground must first be *graded* (leveled). Workers then spread a *filler,* usually stone, and cover it with a thin plastic sheet called a *moisture barrier.* The workers pour concrete over the moisture barrier, forming a slab about 4 inches (10 centimeters) thick. The barrier prevents moisture from coming through the slab.

Some house-building terms

Attic is the space directly below the roof and above the ceiling.
Ceiling joists are beams that rest on the top plate of the studs and support the ceiling.
Conduit is a tube that protects electrical wires.
Dry wall is an interior wall finish made in panels of dry material, usually gypsum. It is covered with paper on both sides.
Duct is a metal pipe for distributing air from the heating and cooling equipment to the rooms of a house.
Eaves are the part of the roof that hangs over the outside wall.
Girder is a heavy piece of timber or steel used for support.
Header is a beam perpendicular to the joists. It is nailed to the joists to make a frame for a chimney, stairway, window, door, or other opening.
Joists are beams that support floors and ceilings. They are supported at the ends by walls, girders, or larger beams.
Lath is a strip of wood, sheet of metal mesh, or panel of plasterboard attached to the inside of the frame. Laths provide support for plaster and tile walls.
Rafter is a sloping piece of lumber that extends from the *ridge* (top edge) of the roof to the eaves. It supports the roof covering.
Sash is the framework that holds glass in a window or door.
Sheathing refers to boards or other materials that cover the wall or roof before the finished siding or roofing is added.
Siding is the outer covering of a frame house. It may be made of wood, metal, or various composition materials.
Stud is a vertical part of the frame.

Some styles of houses

The Georgian house originated in England during the 1700's. It is built on a simple square or rectangular plan. The house has two or more stories and a prominent central entrance.

A Greek revival house displays some characteristics of ancient Greek architecture, such as a row of columns at the front and a *pediment,* a triangular area above the columns.

The Queen Anne style emerged in the late 1800's in England. The house's exterior has irregular shapes and textures, a steep roof, narrow siding, and a large, projecting main entrance.

The shingle style in the United States grew out of the Queen Anne style. It was popular in the late 1800's for houses of wealthy families and was distinguished by shingled walls.

A Tudor house is based on English architecture that was popular during the 1500's. This picturesque style features gables, a large chimney, numerous windows, and elaborate paneling.

The prairie style emerged in the United States during the early 1900's. A prairie house has a low, horizontal profile, with eaves that project beyond the roof and long rows of windows.

The International Style became popular starting in the mid-1900's. The house features geometric shapes, white walls, and a flat roof. The exterior has little or no ornamentation.

WORLD BOOK illustrations by Mark Nelson

The ranch house became popular in the United States in the mid-1900's. All the rooms are arranged on ground level. The house has several windows, including a large picture window.

The frame is the skeleton around which the rest of the house is built. After the footings and foundation have been formed, workers bolt wooden beams called *sills* to the foundation. The sills support the outside walls. *Floor joists,* beams that support the floor, are attached to the sills about 16 inches (40 centimeters) apart. In many cases, the joists run from one sill to the sill on the opposite side of the house. In other cases, the joists run to an intermediate support beam or an interior support wall called a *bearing wall.* Floorboards or plywood nailed on top of the joists make the bottom layer of the floor. The structure is then solid enough to hold the *wall frames.*

Wall frames include vertical pieces of lumber called *studs* and horizontal pieces called *plates.* Carpenters assemble and nail together each wall frame separately before attaching it to the sill. Then they lift each frame into place and brace it temporarily. When all the outside walls have been raised, they are nailed together and braced permanently.

The *sheathing* (the inner layer of the outside walls) may be wood, fiberboard, or plywood nailed to the studs. Usually, builders cover the sheathing with waterproof paper called *building paper* or with a thin plastic sheet called *house wrap.* Then they add the siding. Siding may be aluminum, brick, stone, or wood.

The roof seals the top of the house. Some roofs are flat, but most are slanted to shed rain and snow. Slanted roofs are often formed by pieces of lumber called *rafters.* Carpenters nail the bottom ends of the rafters to the plates at the top of the outside walls. The rafters slant from the plates and meet at the *ridgeboard,* a board placed at the *ridge* (top edge) of the roof, or at a similarly placed *ridge beam.* Rafters support the roof's weight.

After carpenters nail sheathing to the tops of the rafters, they add heavy building paper or roofing felt to it. Then they add the final layer of asphalt, wood, or slate shingles. They usually cover flat roofs with asphalt or with a *membrane roof* of rubber sheet roofing. *Flashing* (strips of sheet metal) placed around the chimney and other roof openings prevents water leakage.

Interior construction includes (1) floors, (2) walls, (3) windows, and (4) doors.

Floors have a lower layer and upper layer. The lower layer, called the *subfloor,* usually consists of sheets of plywood that are $\frac{3}{4}$ inch (1.9 centimeters) thick. Some subfloors may consist of boards nailed at an angle across the floor joists.

The upper layer is known as the *finished* floor. Finished floor coverings include wood; carpeting; linoleum; rubber; cork; and vinyl, ceramic, and stone tile. Wood flooring is often made from *tongue-and-groove boards.* One side of each board has a projecting piece called a *tongue,* and the other side has a matching slot called a *groove.* The tongue of one board fits snugly into the groove of another board. Carpenters drive nails through the groove side so that the nailheads do not show on the finished floor. Most finished floors are made of hardwoods, such as maple or oak, that have been finely sanded. The wood may then receive an application of wax, shellac, varnish, or plastic, or it may be covered with a carpet.

Walls. Rooms are made by building inside walls after the outside walls have been attached to the foundation. Inside walls, also called partitions, are really small-sized frames like the outside walls. They have studs and must be supported by plates, joists, and girders.

If plaster is to be applied, the interior walls must first be covered with *lath*—horizontal strips of wood, metal mesh, or plasterboard. Gypsum wallboard is commonly used instead of plaster on partitions. Wood or plywood boards may also be used.

Windows. Most parts of a window come from a lumber mill or are manufactured by window companies. Windows that open have two parts, the *frame* and the *sash.* The sash, which holds the glass, swings or slides open. The frame fits into the opening left in the structure's frame and is nailed into place. Window frames and sashes may be made of wood, metal, or vinyl.

Doors. Both doors and doorframes may usually be bought ready-made. Carpenters attach the doors high enough to swing over rugs or carpets. A *threshold* fills in the space under an outside door and provides protection against the weather.

Electrical wiring provides lighting and furnishes outlets for lamps, washing machines, and other appliances. In some houses, electric power also provides heat. Before construction starts, the builder determines the location and type of wiring. Wires vary in size, depending on the equipment in the house and how far the current must travel. Standard wiring in the United States is designed for 110-volt current. But builders often specify heavy-duty, 220-volt wiring if large electrical appliances or an air conditioning system are installed.

Electricians install wiring after carpenters have built the frame. Wiring is done in a series of circuits. Each set of wires has several outlets. Electricians often place the wiring for a furnace on a separate circuit. This keeps the furnace running in case another circuit breaks down.

Wires become hot and can cause fires if they are overloaded, so electricians may install a protective switch called a *circuit breaker* for each electrical circuit. If the circuit becomes overloaded, the circuit breaker automatically cuts off the current. Instead of circuit breakers, many older houses have protective devices called *fuses,* which contain a wire that melts easily. If too much current passes through a circuit, the wire in the fuse melts, or "blows." A *fuse box* holds all the fuses.

Plumbing. During construction, plumbers install the pipes that will supply gas and water, and carry away waste. They install bathroom fixtures and sinks just before other workers add the finishing touches to the house. Plumbers also install *traps* to keep out sewer gas. The trap used for bathroom washbasins, for example, is a P-shaped pipe directly below the drain. Water settles in the lower part of the pipe and prevents sewer gas from backing up and leaking into the room. To function properly, traps must have outside ventilation. The *vent* or *vent stack,* the small pipe that projects from the roof of a house, is a ventilating pipe for sewer gas.

A cast-iron waste-disposal pipe runs from inside the house to the outside, where it connects to the city sewerage system. In areas without a city sewerage system, a *septic tank* near the house holds sewage until it dissolves. Water from the sewage flows through pipes into the ground. The sludge remaining in the tank must be removed at intervals.

Insulation reduces the amount of heat or cold that passes through walls, floors, and ceilings. When the air

around the house is warmer or colder than the air inside, heat passes from the warm air to the cold air. This means that in winter, the heat will pass to the outside, and the house will become cold. In summer, the heat outside passes into the house. Insulation fills the air spaces in walls, floors, and ceilings and creates *dead-air space*. This helps prevent heat from passing through. Insulation can save fuel costs in heating a house.

Insulation is made from many materials, including cellulose, rock wool, a glassy lava called *perlite*, gypsum, certain plastics, and fiberglass. Insulation comes as blankets, boards, paper, and sheathing. It is also available in a loose, crumblike form. The type of insulation used depends on the climate and on whether it insulates floors, ceilings, or walls.

Heating and air conditioning. Most houses have *central heating* systems. One furnace or boiler supplies heat for the entire house. Such houses are heated by warm air, steam, or hot water. In hot-air heating, a fan connected to the furnace blows warm air through *ducts* (pipes) into the rooms. In steam or hot-water heating, the steam or hot water produced in a boiler passes through radiators that stand throughout the house. In *radiant* heating, hot-water pipes run under the floors or in the ceilings or walls.

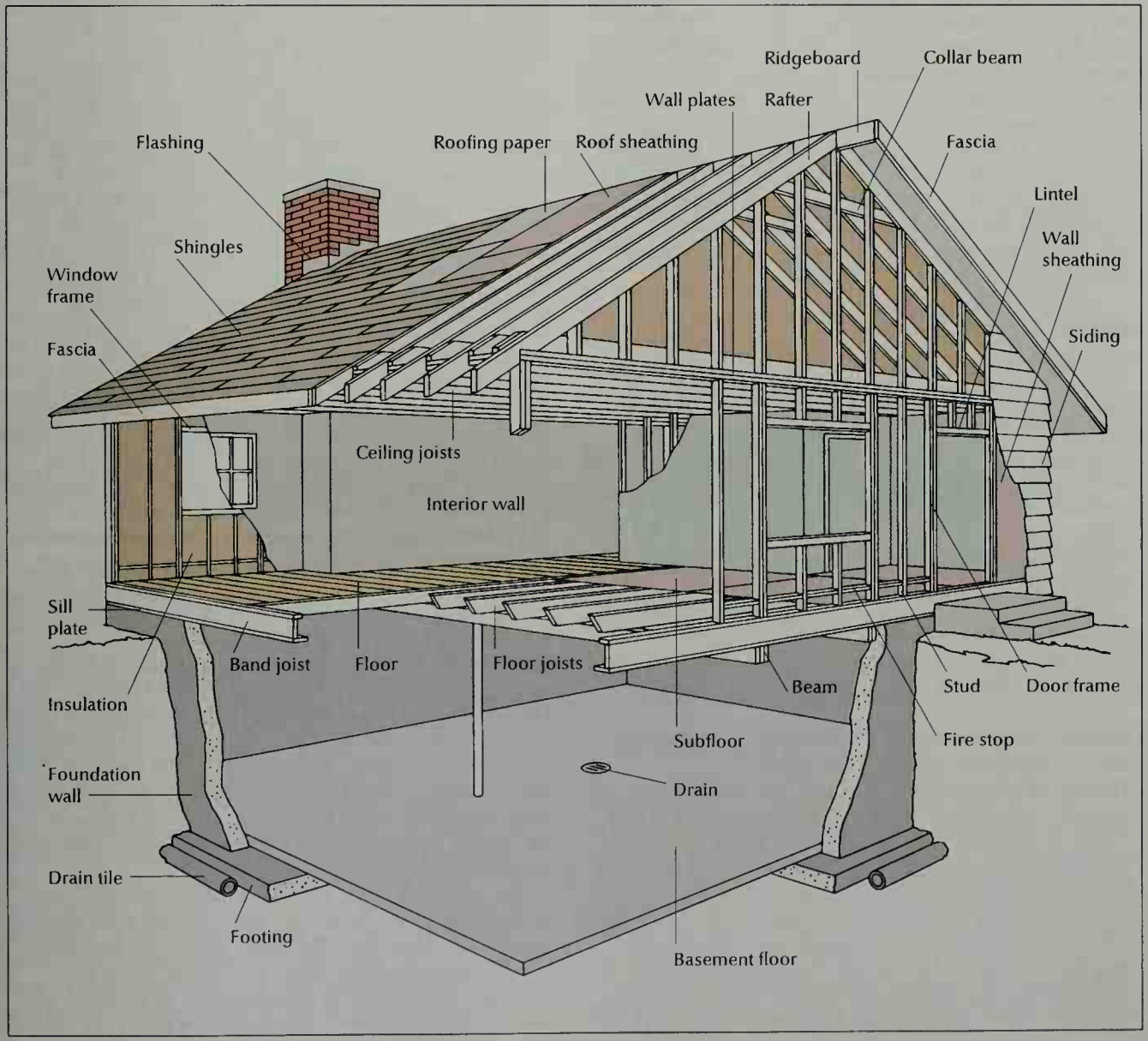
Air-conditioning units may be used to cool houses. An air conditioner takes warm air from the house, cools it, removes moisture, and recirculates cool air. An air conditioner with a heat pump may warm cold air, add moisture, and recirculate warm air.

Interior design. In a new house, the builder usually paints the rooms and finishes the floors as part of the contract with the homeowner. The owner generally selects, buys, and arranges the furnishings. But sometimes the owner hires a professional designer to do this job.

Landscaping is the last step in building a house. Most builders try to keep the natural outline of the land and to preserve the trees. After the house is finished, the builder may plant seed or lay rolls of grass turf for a lawn around the house. The builder may also plant trees and shrubs. The homeowner may have a firm of *landscape contractors* provide landscaping. The homeown-

Some parts of a house

WORLD BOOK diagram by Richard Fickle



er also may hire a *landscape architect* to design a garden or landscape. Stuart E. Cohen

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		Smoke alarm
Cement and concrete	Lighting	Ventilation
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Additional resources

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House, in astrology, is a division of a chart that supposedly reveals a person's character or future. The chart, called a *horoscope,* is divided into 12 houses. The houses represent 12 departments of a person's life: (1) appearance and personality, (2) possessions, (3) family relations, (4) parents, (5) children, (6) health, (7) friends and marriage, (8) death, (9) travel, (10) career, (11) ideals, and (12) illness and sorrow. The houses also are related to 12 imaginary divisions of the earth's surface. Astrologers supposedly tell fortunes by explaining the influence of the planets and stars on each house (see **Horoscope** [Parts of a horoscope]). Christopher McIntosh

See also **Astrology; Zodiac.**

House, Edward Mandell (1858-1938), an American statesman, made secret missions to Europe during World War I (1914-1918) as the representative of United States President Woodrow Wilson. Although House held no official position, he helped Wilson draft the Fourteen Points, a set of principles meant to serve as the basis for a peace treaty to end the war. House helped persuade the Allies to accept the Fourteen Points. In 1919, he served on the American commission at the Versailles Peace Conference and helped plan the League of Nations, a forerunner to the United Nations.

House was born on July 26, 1858, in Houston and attended Cornell University. House became a leader in Texas state politics. He gained national influence in 1912 when he worked on Wilson's presidential campaign. Kendrick A. Clements

House Committee on Un-American Activities. See **Un-American Activities Committee.**

House of Burgesses, *BUR jehs ehz,* was the first representative legislative body in colonial America. It first met at Jamestown, then the capital of Virginia, on July 30, 1619. Governor Sir George Yeardley called the meeting. The session included two citizens, or *burgesses,* from each of the 11 *boroughs* (subdivisions) of Virginia.

The body's first act was to approve an official great seal for the colony. The House also claimed the right to act on all tax laws. In 1621, the House received the authority to make all legislation, but the governor and his council had veto power. The House followed English law and used the procedures of the English Parliament.

After the death of King James I in 1625, the English government became occupied with its internal affairs. From then on, the House of Burgesses managed the affairs of the colony. The failure of Governor Sir William Berkeley to call a new election to the House was one of the many grievances that led to Bacon's Rebellion in 1676 (see **Bacon's Rebellion**).

The House of Burgesses was not entirely democratic. But it contributed to the development of representative government in colonial America. When it was temporarily dissolved in 1774, its members met in the first revolutionary convention of Virginia. There they elected delegates to the First Continental Congress. Some members of the House of Burgesses became leaders of the Revolutionary War in America (1775-1783). Donna J. Spindel

See also **Virginia** (The course toward independence).

House of Commons is one of the two houses of the Parliaments of the United Kingdom and Canada. Canada's House of Commons is modeled after that of the United Kingdom. Both houses consist of representatives elected by the people. In each country, the Commons has much more power than the other house of Parliament. In the United Kingdom, the other house is the House of Lords. In Canada, it is the Senate.

The British House of Commons has 659 members, and Canada's has 301. In both countries, each member represents a voting district called a *constituency.* Members are chosen to run for their seats by their political party, and they need not live in the district they represent.

In both countries, members do not serve fixed terms. They are chosen in a general election, in which the entire nation votes. A general election must be held at least once every five years. If a member dies or resigns, a *by-election* is held in the district to fill the empty seat.

After each general election, the victorious party or coalition of parties organizes the government. The leader of the dominant party becomes prime minister. The governing party or coalition proposes most legislation. For a bill to become law, a majority of the members of the Commons must approve it. In the United Kingdom, the House of Lords cannot prevent a bill passed by the Commons from becoming law. In Canada, the Senate seldom rejects bills outright but sometimes proposes changes. It cannot kill a constitutional amendment that the Commons has approved. Roger H. Davidson

See also **Canada, Government of** (The Parliament); **Parliament; United Kingdom** (Government).

House of Lords is one of the two houses of Parliament, the lawmaking body of the United Kingdom. The House of Lords is less powerful than the House of Commons, the other house. The main function of the House of Lords is to examine bills passed by the House of Commons. The House of Lords often amends bills but rarely challenges their basic principles. After the House of Commons has approved a bill, the House of Lords may delay the measure but cannot defeat it.

The House of Lords has about 700 members. Ninety-two members are *hereditary peers,* drawn from among nobles who inherited their titles. About 600 members are *life peers,* persons given the rank of baron or baroness to honor their achievements in business, civil service, or other fields. Among the life peers are about

30 *law lords,* selected from the nation's highest judges. These members hear final legal appeals. The *lords spiritual* are 26 senior officials of the Church of England.

Parliament was divided into the House of Lords and the House of Commons in the 1300's. The houses had nearly equal power. But in 1832, a reform act removed much of the power of the House of Lords. The Parliamentary Acts of 1911 and 1949 further limited the actions of the Lords. In 1999, legislation abolished the right of hereditary peers to inherit, with their title, a seat in the Lords. Ninety-two hereditary peers, mostly elected by other hereditary peers or by the full House of Lords, were to continue to serve in the Lords until further reform of the house was completed. Robert E. Dowse

See also **Parliament** (The House of Lords).

House of Representatives is one of the two lawmaking bodies of many legislatures. In many of these legislatures, the other chamber is called a *senate,* and the house of representatives is the larger of the two.

The national legislatures of the United States, Australia, Colombia, and Japan have a house of representatives. Most of the 49 two-chamber state legislatures in the United States also have a house of representatives. Nebraska has a one-house legislature. Several states and nations use a different name for a lower chamber. This article focuses on the U.S. House of Representatives.

The U.S. House of Representatives, usually called simply the *House,* is one of the two chambers of Congress. The other chamber is the Senate. The two houses of Congress have about the same amount of power. However, the Senate is frequently called the *upper house,* and the House is known as the *lower house.* Members of the House are generally called *representatives.* The House and Senate must approve identical versions of any legislation before it can become law.

The Constitutional Convention established the form of national government in 1787. But it reached a standstill on the problem of representation in Congress. Delegates from states with large populations favored representation according to population. Those from states that had small populations argued for equal representation for every state. Under a compromise, representation in the House was based on population. Each state was given two senators, regardless of population.

Membership of the U.S. House of Representatives

Size. The Constitution gives Congress the power to determine the size of the House and to distribute representatives among the states. According to the Constitution, each member of the House must represent at least 30,000 persons, but every state must have at least one representative. The Constitution also requires a census of the nation every 10 years to determine how many representatives each state should have.

The first House, which was formed before the initial census had been taken, had 59 members when it originally met and 65 members by the end of the first Congress. The House grew as new states joined the Union and as the nation's population increased. In 1929, Congress passed legislation that limited the House to 435 members. In 1959, when Alaska and Hawaii became states, the House gained two additional members. However, reapportionment took place after the 1960 census, and the House was again limited to 435 members in 1962. Today, the House has one member per about 572,000 people. In addition, the House has one delegate each from the District of Columbia, American Samoa, Guam, and the Virgin Islands and a resident commissioner from Puerto Rico. These five officials can vote in committees and on some questions in the full House.

Number of representatives by state

This table shows the number of representatives each state sends to the U.S. House of Representatives. The number is based on the state's population, but each state must have at least one representative. The House has 435 members.

State	Representatives	State	Representatives
Alabama	7	Montana	1
Alaska	1	Nebraska	3
Arizona	6	Nevada	2
Arkansas	4	New Hampshire	2
California	52	New Jersey	13
Colorado	6	New Mexico	3
Connecticut	6	New York	31
Delaware	1	North Carolina	12
Florida	23	North Dakota	1
Georgia	11	Ohio	19
Hawaii	2	Oklahoma	6
Idaho	2	Oregon	5
Illinois	20	Pennsylvania	21
Indiana	10	Rhode Island	2
Iowa	5	South Carolina	6
Kansas	4	South Dakota	1
Kentucky	6	Tennessee	9
Louisiana	7	Texas	30
Maine	2	Utah	3
Maryland	8	Vermont	1
Massachusetts	10	Virginia	11
Michigan	16	Washington	9
Minnesota	8	West Virginia	3
Mississippi	5	Wisconsin	9
Missouri	9	Wyoming	1

Originally, Congress let each state decide how to choose its own representatives. Some of these states established congressional districts for this purpose. Each of the districts elected one representative. Other states chose all their representatives *at large,* with an entire state serving as one congressional district. In 1842, Congress passed legislation that required every state to create a congressional district for each of its House seats. Under certain conditions, however, one or more of a state's representatives may be chosen at large.

At first, Congress required the congressional districts of each state to have a compact shape and nearly equal populations. However, these rules were largely ignored, and Congress omitted them from the 1929 law that limited the size of the House. In many cases, the most powerful party in a state legislature created oddly shaped districts that differed greatly in population. This practice, called *gerrymandering,* concentrated the supporters of other parties into only a few districts. The dominant party then gained an unfair share of seats in the House of Representatives by winning in all the other districts.

The growth of cities widened the differences in population among congressional districts. For example, a state might have had an urban district of 900,000 persons and a rural district of 150,000. Since each district elected one representative, many urban voters were underrepresented in the House.

During the 1960's, the Supreme Court of the United States largely ended unfair apportionment of House

Speakers of the House of Representatives

Speaker	Party	Years served	Speaker	Party	Years served
Frederick A. C. Muhlenberg	Federalist	1789-1791	*James G. Blaine	Republican	1869-1875
Jonathan Trumbull	Federalist	1791-1793	Michael C. Kerr	Democratic	1875-1876
Frederick A. C. Muhlenberg	Federalist	1793-1795	Samuel J. Randall	Democratic	1876-1881
*Jonathan Dayton	Federalist	1795-1799	J. Warren Keifer	Republican	1881-1883
Theodore Sedgwick	Federalist	1799-1801	John G. Carlisle	Democratic	1883-1889
Nathaniel Macon	Dem.-Rep.†	1801-1807	*Thomas B. Reed	Republican	1889-1891
Joseph B. Varnum	Dem.-Rep.†	1807-1811	Charles F. Crisp	Democratic	1891-1895
*Henry Clay	Nat. Rep.‡	1811-1814	*Thomas B. Reed	Republican	1895-1899
Langdon Cheves	Dem.-Rep.†	1814-1815	David B. Henderson	Republican	1899-1903
*Henry Clay	Nat. Rep.‡	1815-1820	*Joseph G. Cannon	Republican	1903-1911
John W. Taylor	Dem.-Rep.†	1820-1821	James B. Clark	Democratic	1911-1919
Philip P. Barbour	Dem.-Rep.†	1821-1823	Frederick H. Gillett	Republican	1919-1925
*Henry Clay	Nat. Rep.‡	1823-1825	Nicholas Longworth	Republican	1925-1931
John W. Taylor	Dem.-Rep.†	1825-1827	*John N. Garner	Democratic	1931-1933
Andrew Stevenson	Dem.-Rep.†	1827-1834	Henry T. Rainey	Democratic	1933-1935
*John Bell	Whig	1834-1835	Joseph W. Byrns	Democratic	1935-1936
*James K. Polk	Democratic	1835-1839	William B. Bankhead	Democratic	1936-1940
Robert M. T. Hunter	Democratic	1839-1841	*Sam Rayburn	Democratic	1940-1947
John White	Whig	1841-1843	Joseph W. Martin, Jr.	Republican	1947-1949
John W. Jones	Democratic	1843-1845	*Sam Rayburn	Democratic	1949-1953
John W. Davis	Democratic	1845-1847	Joseph W. Martin, Jr.	Republican	1953-1955
Robert C. Winthrop	Whig	1847-1849	*Sam Rayburn	Democratic	1955-1961
Howell Cobb	Democratic	1849-1851	*John W. McCormack	Democratic	1962-1971
Linn Boyd	Democratic	1851-1855	*Carl B. Albert	Democratic	1971-1977
Nathaniel P. Banks	American	1855-1857	*Thomas P. O'Neill	Democratic	1977-1987
James L. Orr	Democratic	1857-1859	*James C. Wright, Jr.	Democratic	1987-1989
William Pennington	Whig	1859-1861	*Thomas S. Foley	Democratic	1989-1995
Galusha A. Grow	Republican	1861-1863	*Newt Gingrich	Republican	1995-1999
*Schuyler Colfax	Republican	1863-1869	*J. Dennis Hastert	Republican	1999-
Theodore M. Pomeroy	Republican	1869			

*Has a separate biography in World Book. †Democratic-Republican. ‡National Republican.

seats. In 1962, it ruled that citizens could ask federal courts to decide cases involving charges of unfair apportionment. In 1964, the court ruled that a state's congressional districts must be as equal in population as possible. As a result, gerrymandering declined as a tool to aid a dominant party.

Qualifications and election. The Constitution requires a representative to be at least 25 years old and to have been a United States citizen for at least seven years. House members must be legal residents of the state from which they are elected. They are not required to live in the district they represent, but nearly all voters insist that they do. Representatives serve two-year terms and are elected in the even-numbered years. There is no limit to the number of terms a representative may serve.

Salary and privileges. The basic salary of House members is $150,000. The speaker, who is the leader of the House, receives $192,600. Members are entitled to annual salary increases based on rises in the cost of living, but they may vote not to accept the increases. Each representative also gets a special allowance that covers such expenses as staff salaries, official mail, travel costs, and office expenses, including rental of office space in the representative's home district. Such factors as distance from the home district and local rent rates determine the exact sum of this allowance. Members of the House of Representatives are also provided with office space in Washington, D.C.

Representatives are given legal *immunity* (protection) for anything they write or say when conducting official

U.S. House of Representatives

The House chamber, where the entire House of Representatives meets, has galleries for the public. Visitors may watch the legislators debate important bills. But most of the actual work of the House is done by committees.

business in the House chamber or in committee meetings. With this immunity, a representative can criticize policies or people without fear of being sued.

Organization of the U.S. House

In January after a congressional election, House members meet to choose their party leaders for the next two years. The meeting of the House Democrats is called the Democratic *caucus,* and that of the Republicans is the Republican *conference.* The representatives deal mainly with organizational matters at these meetings, but they also may adopt party positions on bills.

The speaker and other leaders. The speaker of the House presides over House sessions and gives representatives permission to debate. The speaker also appoints most House members of *joint committees,* which consist of members of both houses of Congress. The speaker is officially elected by the full House but actually has already been chosen at the meeting of the majority party. The House election simply confirms the majority party's choice because representatives support their party's candidates for leadership positions. A representative may hold the job of speaker for no more than four consecutive two-year terms.

The members of the majority party also select the *majority leader* of the House at their meeting. The candidate for speaker chosen by the minority party becomes the *minority leader.* Each party also elects an assistant leader called a *whip.* The whips work to persuade representatives of their party to support party policies.

Committees do most of the House's work. Each party has members on these committees. Representatives may serve on four types of committees: (1) *standing* (permanent), (2) select, (3) conference, and (4) joint.

Standing committees are the most important type. They consider bills that have been introduced in the House. The House has 19 standing committees, each of which handles a particular field of legislation. The most powerful of these committees include Appropriations; Judiciary; Rules; and Ways and Means, which deals with tax bills. Each standing committee may be divided into several subcommittees. The heads of committees and subcommittees are members of the majority party. They are elected at the party conference or caucus by secret ballot. In many cases, the person elected is the majority party representative who has the longest continuous service with the committee or subcommittee. Committee and subcommittee heads may hold their positions for no more than three consecutive two-year terms.

The proportion of Democrats and Republicans on the standing committees reflects that of each party's membership in the House. The Democratic caucus and the Republican conference make the committee assignments, which are then confirmed by the entire House. The speaker nominates the majority party's members of the Rules Committee. Any bill opposed by the Rules Committee has little chance of reaching the entire House for consideration.

Select committees, also called *special committees,* are temporary groups formed for investigations or other special purposes. Conference and joint committees have senators and representatives. Conference committees resolve differences between versions of certain bills that have passed in both chambers. A joint committee deals with topics that concern both chambers, such as energy problems or economic matters.

The work of the House

Considering legislation is the principal activity of the House. Representatives introduce thousands of bills during each session of Congress, and the House passes hundreds of them. All legislation that deals with taxes or spending must originate in the House.

After a bill has been introduced in the House, the speaker assigns it to a standing committee. Most bills die because the committee *tables* them—that is, lays them aside. Other bills are studied, released by the committee, and placed on a *legislative calendar* for consideration by the entire House. House leaders and the Rules Committee bring some bills out of calendar order to give them immediate consideration. A bill dies if Congress does not pass it before adjourning.

Most bills approved by the House are passed without debate. The House approves them under a *unanimous consent agreement,* a method of speeding legislative action. A bill that arouses disagreement among many representatives is likely to be debated. Under House rules, a representative may speak about a bill for one hour. However, representatives seldom get that much time. In most cases, the Rules Committee sets the amount of time for debate and divides it between the supporters and opponents of the legislation. Most bills require the support of only a simple majority—that is, more than half the representatives present—to pass.

Both houses of Congress must pass a bill in identical form for it to become law. A conference committee works out any differences between the House and Senate versions of many major bills. This committee then submits its version to each house for approval.

Bills passed by Congress are sent to the president. The president may sign a bill—and thus make it law—or veto it. If the president fails to act on a bill for 10 days—not including Sundays—while Congress is in session, it becomes law. A bill that reaches the president fewer than 10 days—not including Sundays—before Congress adjourns must be signed to become law. A vetoed bill is returned to Congress. If at least two-thirds of the members present in each house vote to *override* (reverse) the veto, the bill becomes law.

Other powers and duties of the House of Representatives include *impeaching* United States government officials and, under extraordinary conditions, electing the president of the United States. Impeachment is a charge of misconduct in office. The Senate conducts a trial to decide if the impeached official is guilty. The House elects the president if no candidate receives a majority of the votes in the *Electoral College.* The Electoral College is a group of officials chosen by the voters to elect the president and vice president.

Lower houses in other countries

About half of all nations have a two-house legislature. The names of the lower houses include *Chamber of Deputies, House of Commons,* and *National Assembly.* The lower houses in most countries with two-house legislatures have representation according to population. Some countries with such lower houses, including France, Britain, and Italy, have fewer people than the

United States but have larger lower chambers. The lower chamber of most legislatures has more power than the upper chamber.

Members of lower chambers serve terms that range from two to six years. The members of the U.S. House receive a higher salary and more benefits than those of any other lower chamber. Kenneth Janda

Related articles in World Book. See the *Government* section of articles on each nation mentioned, such as Australia (Government). See also the *Legislature* section of each state article, such as Ohio (Legislature). Other related articles include:

Apportionment
Black Caucus, Congressional
Congress of the United States
Constitution of the United States
Gerrymander
House of Commons
Impeachment
Political action committee
Senate
Speaker
State government (Legislative branch)
Term limits
Un-American Activities Committee
United States, Government of the

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House sparrow, also called *English sparrow,* is a dull-colored bird about 6 inches (15 centimeters) long. It has a reddish-brown coat streaked with black, and grayish-white underparts.

Originally, house sparrows lived throughout Europe and Asia. In 1850, they were introduced into the United States, where they have become wild. Today, house sparrows can be found throughout the United States and in much of Canada and Mexico. They are common both in cities and in open country.

House sparrows do not migrate. Even those that breed in northern regions remain there throughout the winter. They eat any kind of food, and so they are able to survive in all kinds of weather and climates. These birds are often considered pests because they destroy grain, fruit, and many growing vegetables.

House sparrows have a shrill song. These birds build their nests in holes, on ledges of buildings, and in trees. The female lays from four to nine eggs, which are usually white with yellowish-green, brown, or black spots. Three or four broods are reared each year.

Sandra L. Vehrencamp

Scientific classification. The house sparrow belongs to the family Passeridae. Its scientific name is *Passer domesticus.*

See also **Bird** (picture: Birds' eggs [House sparrow]); Sparrow.

House spider is a common name for several spiders that often inhabit buildings. One well-known example, the *American house spider,* lives throughout North America. It has a round brown body about $\frac{1}{4}$ inch (6 millimeters) long. The American house spider spins a tangled web, which consists of a jumble of threads.

Other house spiders belong to a group that builds funnel webs. These webs narrow into a funnel at one end, where the spider spends most of its time. *Funnel-web house spiders* once lived only in Europe, but they are now common in North America. They have a spotted brown and gray coloring. One example, the *European house spider,* usually lives in damp places. Other funnel-web house spiders include the *giant house spider,* which has a body up to $\frac{2}{3}$ inch (17 millimeters) long, and the aggressive house spider, which can inflict a painful bite that is slow to heal. All other house spiders are harmless to human beings. In fact, these animals benefit people because they feed on insects that stray indoors.

Edwin W. Minch

Scientific classification. The American house spider is in the family Theridiidae. Its scientific name is *Achaearanea tepidariorum.* Funnel-web house spiders are in the family Agelenidae. The European house spider is *Tegenaria domestica;* the giant house spider, *T. gigantea;* the aggressive house spider, *T. agrestis.*

Houseboat is any kind of floating home. In the United States and Canada, houseboats are used mainly for pleasure. However, some people use them as permanent homes. Most houseboats are built for use on lakes, rivers, and inland waterways.

Houseboats vary in length from 18 to 80 feet (5.5 to 24 meters) and longer. Most have a wood frame with fiberglass or metal siding. The hull can be made of several materials, including wood, steel, fiberglass, or aluminum. Many houseboats have several rooms and all

WORLD BOOK illustration by Trevor Boyer, Linden Artists Ltd.

The male house sparrow, *shown here,* has a black throat and a black-streaked coat. The female has a whitish throat.

© Tom Myers

Modern houseboats enable families to live on the water permanently or while on vacation.

the conveniences of a house on land, including a stove, refrigerator, running water, heaters, and air conditioners. Generators provide electric power.

Many houseboats are designed to remain in the water all year. Some have retractable wheels and may also be used as a camper or trailer. Houseboats can be permanently anchored. They also can be powered by an engine or sail, or by a combination of engine and sail.

Houseboats have long provided homes for many people throughout the world. In the Orient, people have lived on boats called *junks* and *sampans* for hundreds of years. Villages of floating homes and stores are still common in China. During World War II (1939-1945), houseboats were used as United States Navy bases in the Pacific Islands. Michael W. Harris

See also **Asia** (picture: Floating homes); **Sampan**.

Houseleek, also called *live-forever,* is the name of about 40 species of plants native to the mountains of central and southern Europe, northern Africa, and western Asia. The plants have fleshy leaves and grow in large clusters resembling mats or cushions. The star-shaped flowers grow on stalks that are commonly 4 to 8 inches (10 to 20 centimeters) high. Houseleeks are often seen in rock gardens, on stone walls, and on slate or thatch roofs in Europe. They are *perennials,* meaning they can live over two years. They often reproduce by means of buds that grow from the roots. Juice from houseleek leaves has been said to relieve the pain of burns and bee stings. People once thought the plant protected homes against lightning. Philip W. Rundel

WORLD BOOK illustration by Christabel King

Houseleek

Scientific classification. Houseleeks make up the genus *Sempervivum* in the family Crassulaceae.

Housing includes any kind of building that provides shelter for people. In a broader sense, it includes problems of city planning, and community services that provide good living conditions.

Safe, sanitary, comfortable dwellings are called *standard housing.* Housing that has proper heating and ventilation helps people stay in good health. Good housing provides enough space for every member of the family to have some privacy and freedom. Standard housing includes hot and cold running water and a well-planned sewage disposal system. It also provides electric light at night and lets in plenty of sunlight by day.

Poorly constructed, run-down, unsanitary, or overcrowded dwellings are called *substandard housing.* Using this definition, most of the world's people live in substandard housing. Many people in Europe's less industrialized countries are badly housed. Throughout Asia, Africa, and Latin America, millions live in crude dwellings that barely provide shelter. The quality of housing in the United States has been improving steadily. Yet, numerous U.S. households today have substandard dwellings. A *household* is made up of all the people living in one housing unit.

A neighborhood with many substandard buildings is called a slum. The older, central areas of cities often deteriorate and become slums. Most occupants of slums have low incomes, and several families may live in one dwelling unit. As a neighborhood begins to decline, many residents who can afford to move to better areas do so. Their homes may be taken over by people moving into the city who cannot afford better housing. Most slums have high rates of illness, disease, and crime. Slums also have inferior community services, including poor schools, inadequate police and fire protection, infrequent garbage collection, and too few parks and playgrounds. Some financial institutions refuse to make mortgage or home-improvement loans in neighborhoods they consider to be declining. This practice is known as *redlining,* from the practice of some financial institutions of outlining such areas in red on maps. Redlining may speed the development of slums by preventing the purchase or repair of houses in such neighborhoods. During the 1970's, several cities and states passed laws designed to discourage redlining.

Prejudice and discrimination prevent many members of minority groups from having adequate housing. In many Western countries, nonwhites, Jews, and immigrants have been forced to live in slums or segregated areas known as *ghettos.* Increasingly, legislation has been used to try to eliminate such conditions and to make good housing available to all.

Kinds of housing

The people of the United States live in more than 80 million housing units. These include houses, apartment buildings, hotels, motels, and *mobile homes* (trailers). An

© Brent Jones

Substandard housing. Millions of people throughout the world live in run-down, unsanitary, or overcrowded dwellings.

average of three persons live in each unit. Permanent housing lasts 50 to 75 years, or even longer. Most dwellings in the United States are permanent buildings made of lumber, brick, or concrete. Mobile homes can be moved from place to place, but they are now usually designed for year-round living at one location.

About 70 percent of the households in the United States live in *single-family homes.* About 15 percent live in buildings of two to four apartments or in commercial buildings that include apartments. About 15 percent of America's households also live in *apartment buildings* with five or more apartments. Cities have more apartment buildings than do small towns and suburban areas, which have mostly single-family homes.

Baltimore, Philadelphia, and some other cities have many *row houses.* Most row houses, sometimes called *town houses,* are a series of single-family houses. At least one common wall connects each house with the houses next to it. A *duplex* is a building with two apartments, either side by side or one above the other.

Private housing

Home ownership is the goal of many Americans. By the end of the 1990's, about two-thirds of the nation's households owned their own homes. Most home buyers make a down payment on part of the purchase price and borrow the rest of the money.

Unlike most other countries, the United States provides an important incentive to encourage people to become the owners of their homes. It does this by allowing homeowners to deduct the interest they pay on their mortgage when determining their taxable income. This allowance is a significant form of government subsidy to homeowners. In fact, this subsidy is significantly greater than the U.S. government's combined subsidy to all public and assisted housing for lower income groups.

There has been a great need for housing since World War II ended in 1945. *Speculative builders* have built many housing developments on a "mass-production" basis. These builders buy land and then build and sell homes on it. Most of the homes are built to suit what is regarded as the average family's desires. *Custom-built* homes (homes built according to the owner's plan) are built by *contract builders* on the owner's land.

Phil Degginger, Bruce Coleman Inc.

Single-family homes provide housing for about 70 percent of the households of the United States.

Private housing projects are groups of buildings erected at the same time for several hundred or several thousand families. A housing project may have a group of small houses built much alike to save costs, row houses, or apartment buildings, or a mix of all three.

Local governments often encourage large insurance companies or other institutions to build communities of homes and apartments. Some cities and states grant such companies special tax reductions on the property. Or they may clear the land to rid it of slums and then sell it to a private developer.

Fresh Meadows in New York City, built by the New York Life Insurance Company, is an example of a private housing project. Fresh Meadows covers 174 acres (70 hectares) and houses 11,000 persons in more than 3,000 apartments. The apartments range in size from three to six rooms. Two 13-story buildings have a total of 600 apartments, and the other units are in 137 garden-apartment buildings. These units are two or three stories high, grouped around grassy lawns, with trees, flowers, and shrubbery, and a recreation area.

Suburban developments. Most housing erected by individuals or private contractors is built on vacant land on the outskirts of cities and towns. Vacant land generally costs less in outlying areas, and there are no buildings that must be destroyed before construction can begin. Most of these new dwellings are one-family houses on lots of up to $\frac{1}{2}$ acre (0.2 hectare) and are bought by the families who move into them.

Every year, thousands of families move into newly built suburban homes. Entire new communities have been built with shops, motion-picture theaters, schools, churches, and parks. Many big-city stores have branches in shopping centers in these communities.

New towns. In some cases, the growth of cities has taken the form of developments called *new towns.* Such planned communities are more complex than are suburban developments. Unlike most residential suburbs, new towns include factories and industries, and many of the residents both work and live in the community.

Cooperative housing. People sometimes form nonprofit corporations to plan, finance, build, and manage the apartment buildings or houses in which they live. When a cooperative builds or buys an apartment building, individuals buy shares in the corporation. The shares entitle them to occupy apartments but not to own the units. They share the expense of maintenance, repair, and improvement for the entire building.

Condominium housing resembles cooperative housing, with one important difference. In condominium housing, the occupants each own their own dwelling units, and each has a share in the parts of the building used by all occupants. They share expenses only for those parts of the building and those services that all of them use. If one or more occupants fail to meet their financial obligations toward their own units, the other occupants are not affected. In cooperative housing, all shareholders are responsible if some occupants fail to meet their financial obligations.

Farm housing. There are about 3 million farm homes in the United States. Over half are owned by the families who live in them. Before the 1930's, most farm homes lacked electricity and indoor plumbing. The Rural

Electrification Act of 1936 provided for federal loans to companies, cities, and other groups for building rural power lines (see **Rural Electrification Administration**). By the late 1960's, almost all U.S. farms had electricity and telephones, and most had indoor plumbing.

Low-income and assisted housing

Many people in the United States cannot afford the rents or mortgage payments for standard housing. Federal, state, and city governments have established programs to provide assistance for low-income families. Most federal housing aid is administered by the Department of Housing and Urban Development (HUD).

Public housing for low-income families has traditionally been provided by city housing *authorities* (organizations). These authorities are established under state laws that also permit their participation in federally aided programs. Most local housing authorities are composed of commissioners appointed by the mayor or the local governing body. The authority determines the need for public housing and then plans, develops, and manages the projects. In many cities, the demand for public housing exceeds the supply.

Public housing may be provided in several ways. The authority may build new housing or buy it from a developer. It may buy existing housing and restore it to good condition. Or it may lease existing housing.

The federal government, through HUD, provides funds for local housing authorities to build and operate public housing. It pays the difference between the cost of the housing and the rents that low-income families can afford. A family pays no more than 30 percent of its income for rent. The low-rent public housing program was established by the U.S. Housing Act of 1937. Since then, all the states have approved projects under the program. Today, there are about $2\frac{1}{4}$ million public housing units in the United States.

Other housing programs encourage the development of private housing for low-income families. Under one of these programs, HUD provides cash allowances to enable low-income families to rent housing on the private market. Families receive an allowance to make up the difference between what they can afford and the actual cost of housing in their area. There are about $1\frac{1}{4}$ million private housing units receiving rent subsidies from the government.

Under another program, the Federal Housing Administration (FHA) provides mortgage insurance to a nonprofit organization that develops a project. The FHA also insures loans to private groups to provide housing for low- and moderate-income families.

Several federal programs make special provisions for elderly persons with low incomes. These programs include public housing, FHA mortgage insurance, and direct loans for nonprofit rental housing. Some states also have housing programs for the elderly.

© Carl Purcell

Row houses, also called *town houses,* provide comfortable housing for many urban families. A number of such developments have common areas that may be used by all residents.

Local housing controls

Building codes control the construction of new dwellings. They require that new structures be sturdily built, provide reasonable room sizes, and receive ample light and air. In most U.S. cities, the local government must approve the plans of a new building. The city then issues a building permit.

Housing codes have been adopted by many cities to insure that older housing is maintained in good condition. These codes require that housing have adequate lighting, ventilation, exits, heating, water, toilets, and garbage and waste disposal. The codes require owners to keep housing sanitary, to remove fire hazards, and to keep the building in good repair. Many housing codes limit the number of people that may sleep in one room.

Zoning laws. Many city and other local governments control the types of buildings that can be erected in a given place. The city is divided into residential, commercial, institutional, and industrial areas. Zoning laws assure owners of residential property that nearby vacant land will not be used for industrial or commercial purposes. These laws also prevent housing that may be constructed nearby from being built at a higher density than existing housing. See **Zoning**.

History

During colonial times, most people in the United States lived on farms or in small towns. As late as 1840, only about 8 percent of the people lived in cities or towns with populations of more than 8,000. Today, about 80 percent live in urban areas.

The Industrial Revolution, which began in the 1700's, produced much unplanned city development. Thousands of people moved to cities to find work, and builders put up almost any kind of housing to meet the demand. Many businesses, factories, and houses stood side by side on narrow streets. Blocks of tenement houses appeared in large cities of the United States, Britain, France, and other industrial countries. The first housing law in the United States was passed by New York City in 1867. The law set minimum ventilation, sanitation, and safety requirements for tenements.

By the 1900's, a world housing shortage existed, chiefly because of the population increase and the concentration of the population in urban areas. The expansion of industry, a shortage of construction workers, and a lack of money for new housing also helped cause the housing shortage.

Housing Since 1900. New housing construction fell

to inadequate levels during World Wars I and II because builders lacked materials. During the Great Depression of the 1930's, people had little money for building. During the 1960's, more and more families moved from rural areas to cities, causing serious housing shortages in spite of stepped-up housing construction.

The United States had a prosperous period and a building boom in the 1920's. The depression of the 1930's led the government to take an active part in housing. The Public Works Administration (PWA) built 59 projects in 36 cities. The FHA, created under the National Housing Act of 1934, established the *amortized mortgage*. This type of mortgage can be repaid in monthly installments, rather than in a lump sum. The United States Housing Act of 1937 set up a U.S. Housing Authority to help build public housing for low-income families. Federal housing activities were unified under the National Housing Agency in 1942 and, after 1947, under the Housing and Home Finance Agency. The Farmers Home Administration was established in 1946 to provide loans for rural housing. The administration operated until 1994, when the new Rural Housing and Community Development Service took over responsibility for making such loans.

E. R. Degginger

Apartment buildings like this high-rise in the Brooklyn borough of New York City are the homes of millions of people. Most tall apartment buildings are located in heavily populated areas, where land is scarce and expensive.

Housing construction increased rapidly after World War II. Since 1949, private builders have constructed more than a million housing units yearly. The high point came in 1950, when they built almost 2 million new units. In the late 1960's, over half of all the homes in the United States had been built since 1945.

In 1965, the Department of Housing and Urban Development was created as an executive department of the United States government. The department seeks to improve urban housing. In April 1968, Congress passed a civil rights bill aimed at eliminating discrimination on the basis of race, color, or religion in the sale or rental of most housing. In June 1968, the Supreme Court ruled that the government had the authority to enforce housing-discrimination laws even in cases involving only private individuals. Earlier, such laws had been applied only to cases involving government agencies. During the 1960's, many states and cities passed fair housing laws. But despite these laws, most communities in the United States are still largely racially segregated by custom.

Condominiums became increasingly popular in the United States during the 1970's. Many rental apartment buildings were purchased by developers and turned into condominiums. This trend reduced the number of available rental units and led to an increased demand for such units, resulting in higher rents.

During the early 1980's, HUD ordered a stop to construction of new public housing. This action, designed to reduce federal spending and future obligations, worsened the existing shortage of housing for poor people. In the mid-1980's, a lowering of interest rates revived a housing industry troubled by previous high rates of interest. By 1990, however, the lack of government subsidy programs had placed about a third of Americans out of the housing market. Many U.S. housing experts believe that affordable housing has become a major national need. In 1990, Congress passed a bill to increase financial assistance to poor people who are seeking to become homeowners.

Canada. Private citizens build most housing in Canada. The Canada Mortgage and Housing Corporation, a government agency similar to the FHA, insures mortgage loans. Canada built about 3 million new housing units from the mid-1940's to the late 1960's. Since 1960, Canadians have spent from $1\frac{1}{2}$ billion to almost $3 billion a year on new housing.

Other countries. Millions of homes were damaged or destroyed in Europe during World War II (1939-1945). Since then, most of the housing built in Europe consists of government-owned, multifamily apartments that are rented at low cost. The apartments are generally small by U.S. standards. But they provide hot and cold running water, heat, electricity, and separate rooms for parents and children of each sex. Many people in almost every class, from unskilled worker to professional, live in government housing in Europe.

China has about a billion people, most of whom live in eastern China. The soil in this region of the country is fertile, and so housing competes for space with valuable farmland. Thus, China can provide only the most minimal housing. The typical Chinese family lives in one room the size of a modest American living room. If running water is available, it is most often a single tap providing cold water. Toilets and bathing facilities are

shared by many people. In the mid-1980's, China began massive new housing programs. But the new housing is still well below American and Western European standards. Oscar Newman

Related articles in *World Book* include:

Architecture
Building construction
City planning
Condominium
Federal Housing Administration
Federal National Mortgage Association
Hill, Octavia
Homelessness
Hotel
House
Houseboat
Housing and Urban Development, Department of
Levitt, William J.
Mortgage
Motel
Open housing
Sanitation
Segregation
Shelter
Tenement
Urban renewal
Veterans Affairs, Department of

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Housing and Urban Development, Department of (HUD), is an executive department of the United States government. The department works to increase the affordability and quality of housing in the United States. It also helps cities improve their economies and revive run-down neighborhoods.

HUD is headed by the secretary of housing and urban development, a member of the president's Cabinet. The secretary is appointed by the president, subject to approval by the U.S. Senate.

Functions. HUD helps make housing more affordable partly by insuring mortgages. The insurance increases the willingness of banks to grant mortgages to home buyers and to people who wish to build or improve rental units. A HUD agency known as the Federal Housing Administration (FHA) provides the insurance.

Another HUD agency, the Government National Mortgage Association, works to increase the availability of mortgages by attracting investors to the home mortgage market. The association is often referred to by its initials, GNMA, and by the nickname *Ginnie Mae.*

HUD also helps provide decent housing for low-income families. For example, it grants federal funds to local housing authorities for the construction, operation, and modernization of *public housing.* Public housing is built specifically to provide homes for low-income people. HUD pays the difference between the cost of maintaining public housing and the rents that low-income families can afford. HUD also promotes resident management and ownership of public housing. In addition, it makes loans to sponsors of nonprofit housing for elderly or disabled people.

HUD grants money to state and local governments to assist in financing community-development programs.

The seal of the Department of Housing and Urban Development

Secretaries of housing and urban development

Name	Took office	Under president
* Robert C. Weaver	1966	Johnson
George W. Romney	1969	Nixon
* James T. Lynn	1973	Nixon, Ford
* Carla A. Hills	1975	Ford
* Patricia R. Harris	1977	Carter
Moon Landrieu	1979	Carter
* Samuel R. Pierce, Jr.	1981	Reagan
* Jack F. Kemp	1989	G. H. W. Bush
* Henry G. Cisneros	1993	Clinton
Andrew M. Cuomo	1997	Clinton
Melquiades R. Martinez	2001	G. W. Bush

*Has a separate biography in *World Book.*

Cities and urban counties use HUD funds to help revive their economies and to replace slums with improved neighborhoods. Some HUD funds are used to provide shelter and services for homeless people.

HUD promotes fair housing and equal opportunity for all, regardless of race, religion, sex, or national origin. It also seeks equal opportunity for the disabled and for families with children.

History. The U.S. government took an active part in housing long before HUD was created in 1965. The Great Depression of the 1930's caused widespread financial hardship. In 1934, Congress founded the Federal Housing Administration to provide mortgage insurance programs. Congress established the United States Housing Authority in 1937 to help finance public housing for the poor. The two agencies were joined under the National Housing Agency in 1942. They became part of the Housing and Home Finance Agency (HHFA) in 1947.

Rapid urban growth during the 1950's and 1960's caused many housing and community problems. Congress created the Department of Housing and Urban Development in 1965 to solve such problems. The HHFA and all of its programs were transferred to HUD and became the core of the new department.

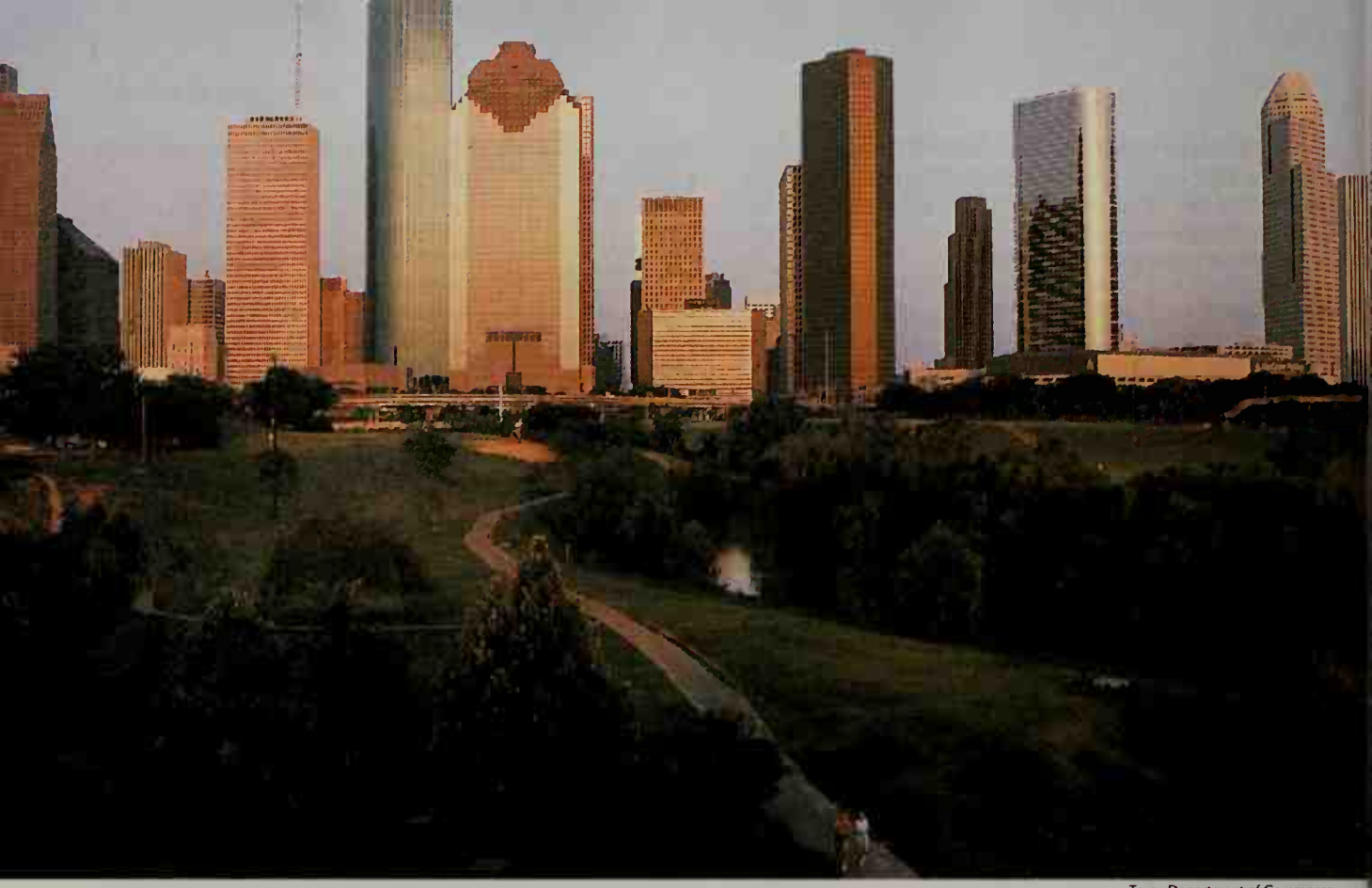
In the 1980's, Congress reduced HUD's role in urban renewal by sharply cutting federal aid for the revival of run-down neighborhoods. As a result, much of the burden of financing urban renewal shifted to city and state governments.

Critically reviewed by the Department of Housing and Urban Development

See also **Federal Housing Administration; Flag** (picture: Flags of the U.S. government); **Government National Mortgage Association; Open housing; Urban renewal.**

Housman, *HOWS muhn,* **A. E.** (1859-1936), a British poet and scholar, wrote melancholy lyrics about human suffering. His outlook on life was pessimistic, and his poems characteristically express the fleeting quality of love and beauty. During his lifetime, only two books of his verse were published: *A Shropshire Lad* (1896) and *Last Poems* (1922). After his death, his brother Laurence published *More Poems* (1936), *Collected Poems* (1939), and *Manuscript Poems* (1955).

Alfred Edward Housman was born on March 26, 1859, in Fockbury, England. He was a classical scholar and taught Latin at the University of London and at Cambridge University. William Harmon



Texas Department of Commerce

Downtown Houston has many tall, modern office buildings. Houston is the largest city in Texas and one of the biggest in the United States. The city ranks as a leading commercial, cultural, educational, and transportation center of the Southwest.

Houston

The city

Houston, *HYOO stuhn,* is a large city in Texas and a leading commercial, cultural, and educational center of the Southwest. Houston ranks as the fourth largest city in the United States. Only New York City, Los Angeles, and Chicago have more people.

Houston lies in southeast Texas, about 50 miles (80 kilometers) from the Gulf of Mexico. Despite its inland location, Houston is one of the world's major seaports. The Houston Ship Channel links the city to the gulf and enables ships to sail to and from Houston.

Houston's economy has traditionally centered on energy in addition to shipping. The Southwest contains rich oil deposits, and the Houston area is the nation's leading oil-refining center. Since the mid-1980's, Houston has also tried to attract other businesses to decrease its dependence on petroleum-related jobs.

Houston has become famous as the home of the Lyndon B. Johnson Space Center. The center serves as the headquarters for piloted space flight programs of the National Aeronautics and Space Administration (NASA). The Texas Medical Center in Houston is an advanced medical center devoted to medical research and education and patient care. It is one of the leading institutions of its kind.

Two real estate promoters, the brothers Augustus C. and John K. Allen, founded Houston in 1836. They named the city for General Sam Houston, who led the army that won Texas's independence from Mexico that year.

Layout of Houston. Most of Houston is in Harris County, but its borders also cross into Fort Bend and Montgomery counties. The city rests on primarily flatland. Buffalo Bayou, a stream that flows from west to east, winds past the northern part of downtown and becomes the Houston Ship Channel farther east. The Turning Basin is at the western end of the ship channel. Large ships can turn around in the Turning Basin.

Many modern glass and steel office buildings rise above the central business district and other parts of downtown Houston. The city is home to several of the world's tallest buildings, including the 75-story Chase Tower and the 71-story First Interstate Bank Plaza.

Houston is the seat of Harris County. City and county government offices are in downtown Houston, as are criminal, civil, and federal courts. The theater district is also downtown and includes the Gus S. Wortham Theater Center and the Jesse H. Jones Hall for the Performing Arts.

An underground network of air-conditioned tunnels connects many of the main buildings downtown. The tunnel system has its own stores and restaurants. Houston summers are hot and humid, and the tunnel system enables people to move about the downtown area in comfort.

The Uptown area is an office and retail center about 5 miles (8 kilometers) west of downtown. It includes the 64-story Transco Tower and the Galleria, a 45-acre (18-hectare) indoor shopping mall and business complex.

The Galleria features fashionable stores, hotels, offices, and an ice-skating rink that is open the year around.

Residential communities extend in all directions from the city's downtown. Several of Houston's oldest neighborhoods are in what were the city's first political districts, the First through Sixth wards. Numerous residential areas were developed through the years as the city expanded. In addition, several *master-planned communities* have been built along the city's edges. These modern residential neighborhoods are designed to include housing, shopping areas, schools, offices, and, in many cases, such recreational facilities as golf courses and swimming pools.

Landmarks. The Astrodome, completed in 1965, was the world's first baseball and football stadium to be completely covered by a roof. Today, a variety of entertainment and sports events are held there. The stadium is part of a complex that also includes an exhibition and convention hall and an arena. The complex lies southwest of downtown.

The Johnson Space Center, in southeastern Houston, is home to NASA's Mission Control, which directs all U.S. piloted space flights after launch. The center serves as the training headquarters for the nation's astronaut corps. A visitor's center called Space Center Houston is next to the NASA complex. It includes spacecraft from past missions, and exhibits and films dealing with the U.S. space program.

San Jacinto Battleground State Historical Park, about 20 miles (32 kilometers) east of downtown, marks the site where Texas won its independence from Mexico in 1836. The San Jacinto Monument towers 570 feet (174 meters) above the battleground. The park also includes a regional history museum.

Metropolitan Houston includes Harris County and five other counties—Chambers, Fort Bend, Liberty, Montgomery, and Waller. Ten communities, each with its own government, lie within Houston's city limits. They are Bellaire, Bunker Hill Village, Hedwig Village, Hilshire Village, Humble, Hunters Creek Village, Piney Point Village, Southside Place, Spring Valley, and West University Place.

Cities surrounding Houston include Baytown, Deer Park, La Porte, League City, Missouri City, and Pasadena. Galveston, a seaport and tourist center, lies approximately 45 miles (72 kilometers) from Houston on the Gulf coast.

People

Ethnic groups. People from more than 100 ethnic groups and cultures live in Houston. About 49 percent of the city's residents are white, and about 25 percent are black. The remaining 26 percent consist of people of American Indian, Asian, or other ancestry.

People of Hispanic descent make up about 37 percent of the city's population. Most Hispanics are white. Others are blacks or people of mixed ancestry. Houston's population also includes many people of English, French, German, Irish, or Italian descent.

Housing. In general, Houston's housing is newer than that of most other big cities. Master-planned communities, such as Kingwood, lie on the city's outskirts.

Some of Houston's oldest Hispanic neighborhoods are in the Harris-Navigation area. Navigation Boulevard runs along the southern bank of Buffalo Bayou between downtown Houston and a street called Harrisburg to the east. Acres Homes, in northwest Houston, has a large black population. The Sharpstown-Alief area and other southwest sections of the city have many people of Asian ancestry.

The Houston Heights neighborhood, north of downtown, is noted for its many well-preserved homes from the late 1800's and the early 1900's. The Montrose area, on the southern edge of downtown, features elegant old mansions, bungalows, and some of Houston's top nightclubs and restaurants. Some of the wealthiest neighborhoods lie west of downtown. The most luxurious residential area is River Oaks. Mansions line its main street, River Oaks Boulevard. The Memorial and Tanglewood areas are also known for their lovely homes.

Houston, like other large cities, has areas of older, rundown buildings. The area east of downtown is an example.

Education. The Houston Independent School District is the largest school district in Texas. It has about 245 schools and about 200,000 students. About 25,000 students attend approximately 300 private and church-supported schools.

Facts in brief

Population: *City*—1,953,631. *Metropolitan area*—4,177,646. *Consolidated metropolitan area*—4,669,571.
Area: *City*—598 mi² (1,549 km²), including 40 mi² (104 km²) of inland water. *Metropolitan area*—5,921 mi² (15,335 km²), excluding inland water. *Consolidated metropolitan area*—7,707 mi² (19,961 km²), excluding inland water.
Climate: *Average temperature*—January, 55 °F (13 °C); July, 83 °F (28 °C). *Average annual precipitation* (rainfall, melted snow, and other forms of moisture)—45 in (114 cm).
Government: Mayor-council. *Terms*—2 years for the mayor and the 14 council members.
Founded: 1836. Incorporated as a city in 1837.

Largest communities in the Houston area

Name	Population	Name	Population
Houston	1,953,631	Missouri City	52,913
Pasadena	141,674	Conroe	36,811
Baytown	66,430	Spring*	36,385
Sugar Land	63,328	Atascocita*	35,757
The Woodlands*	55,649	La Porte	31,880

*Unincorporated
Source: 2000 census.

City of Houston

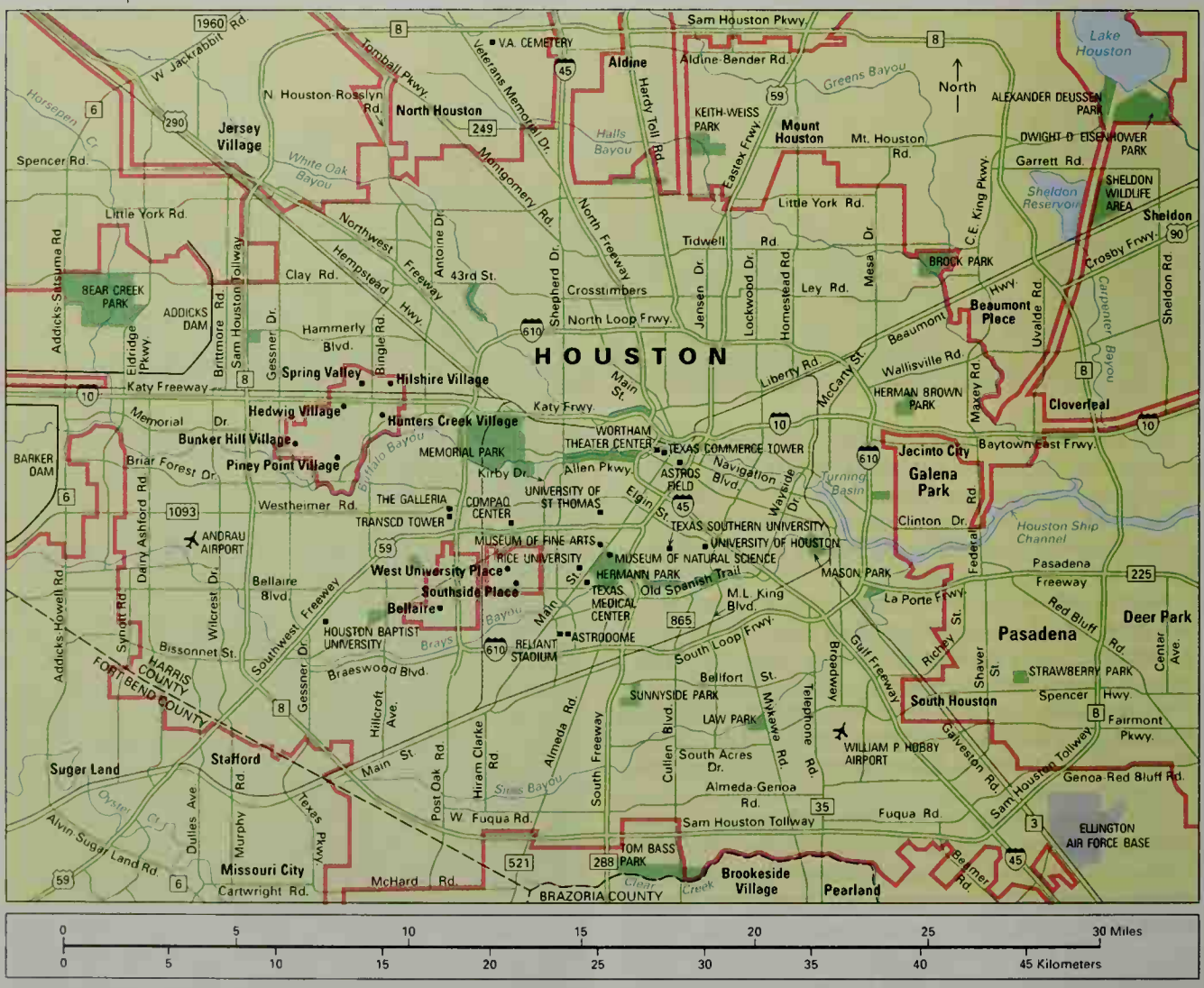
Symbols of Houston. The white star on the blue flag of Houston represents the state of Texas. Both the flag and the city seal bear the city and state names, a locomotive that stands for progress, and a plow that represents agriculture.

Houston

Houston lies in southeastern Texas. It is the seat of Harris County. The small map shows Houston and its surrounding area. The large map shows the city (outlined in red) and points of interest in the area.

City boundary
County boundary
Park
Expressway
Other road
Railroad
Point of interest

WORLD BOOK maps



Rice University and the University of Houston are among the city's best-known institutions of higher learning. Other schools of higher education include Houston Community College, Houston Baptist University, Texas Southern University, and the University of Saint Thomas.

The Texas Medical Center includes the Baylor College of Medicine, the Texas Woman's University, and the University of Texas Health Science Center. The University of Texas M. D. Anderson Cancer Center, one of the world's leading cancer treatment and research institutions, is based in the medical center.

Social problems of Houston are similar to those of other large and rapidly growing urban areas. Gang activities are a problem in many neighborhoods.

Buses are the only form of public transportation in Houston, and traffic jams are common on area expressways. Air pollution is a problem, largely due to emissions from automobiles, trucks, and petrochemical and refinery plants along the Houston Ship Canal.

Houston's lack of *zoning regulations* has also led to problems for some of the city's residents. Zoning regulations control the use of land and divide a city into areas for commercial, industrial, residential, and other developments. Many of Houston's real estate developers and other business leaders long fought such restrictions. They argued that the lack of zoning regulations encour-

© Nik Wheeler, Corbis

The Galleria in Houston includes fashionable stores, hotels, offices, and an ice-skating rink that is open the year around. The Galleria is in the Uptown area, an office and retail center about 5 miles (8 kilometers) west of downtown Houston.

aged Houston's economic growth over the years. Without such restrictions, however, Houston grew in a random manner, with many commercial operations moving into residential areas. A number of neighborhood groups protested this situation. In 1991, the City Council named a commission to develop a zoning plan to give the city more orderly growth. The commission proposed a plan to city leaders in 1993. But a community vote that same year defeated the plan.

Cultural life

The arts. The Houston Grand Opera and the Houston Ballet perform at the magnificent Gus S. Wortham Theater Center located in the downtown theater district. The Jesse H. Jones Hall is the home of the Houston Symphony. Founded in 1913, this orchestra is the oldest performing arts organization in Texas. Houston's nationally known Alley Theatre company, established in 1947, is one of the oldest resident theater groups in the United States.

Museums and libraries. The Museum of Fine Arts became the first art museum in Texas when it was founded in 1900. Its collection of about 27,000 works includes paintings and sculptures from Europe and art from Africa, the Americas, East Asia, and the Pacific Islands. The Bayou Bend Collection and Gardens, a branch of the Museum of Fine Arts, features American decorative arts, such as ceramics, furniture, and textiles. The Contemporary Arts Museum, founded in 1948, exhibits works by modern artists.

The Children's Museum gives children the opportunity to engage in art projects or participate in hands-on exhibits on cultural and scientific subjects. The Houston Museum of Natural Science is known for its impressive collection of gems and minerals. The museum also includes the Burke Baker Planetarium and a theater that shows films on a screen six stories tall.

The Houston Public Library system consists of a main library and branch libraries throughout the city. The system owns nearly 4 million volumes.

Recreation. Houston has more than 400 parks. The parks cover more than 20,000 acres (8,000 hectares) of land. Memorial Park, one of the city's best known parks, features a golf course, tennis courts, and jogging trails. It is also the home of the Houston Arboretum and Nature Center. Hermann Park includes the Houston Zoo and the Miller Outdoor Theatre, the Houston Symphony's summer home.

The city's professional sports teams include the

Karen A. McCormack

The Houston Museum of Natural Science features exhibits on dinosaurs and other subjects in natural history and science.

Houston Astros baseball team of the National League and the Houston Rockets of the National Basketball Association. The city is also the home of the Houston Texans of the National Football League.

The Houston Livestock Show and Rodeo, held from late February to early March, is the largest event of its kind in the nation. Among its attractions are performances by country music stars and other famous entertainers. Established in 1932, the event raises money for scholarships for area children.

Economy

Through the years, Houston has seen its fortunes rise and fall with the price of oil. For example, the city experienced booming growth from 1973 to 1981, when energy prices soared. But falling oil prices from the early to middle 1980's hurt the city's economy. From 1982 to 1986, the Houston area lost about 221,900 jobs—nearly 15 percent of its employment opportunities.

Houston's economy recovered in the 1990's. The city's role as a supplier of energy to the nation continues. Foreign trade through the Houston Ship Canal has increased. The Texas Medical Center provides many jobs. Technology companies also provide employment for many Houstonians. Construction, retail trade, and finance are also important to the economy.

Manufacturing. About 30 of the largest oil companies in the United States have headquarters in Houston. The Houston and southeast Texas Gulf Coast area is the largest oil-refining center in the nation. Houston also ranks as the leading U.S. manufacturer of petroleum equipment.

The Houston area produces huge quantities of *petrochemicals*. Petrochemicals are chemicals made from crude oil or natural gas, such as benzene and ethylene. Houston manufactures high-technology equipment for use in medicine and the space program. Other important industries in the Houston area produce food products, machinery, fabricated metals, paper and paper products, textiles, and transportation equipment.

Transportation and communication. Houston is a major transportation hub of the Southwest. Ships carry cargo between the busy Port of Houston and other seaports. Houston has two major airports, George Bush Intercontinental Airport/Houston and the smaller William P. Hobby Airport. Passenger trains, rail freight lines, and truck lines serve the city. Freeways loop around downtown and link the city with its suburbs. The city has one general daily newspaper, the *Houston Chronicle*.

Government

Houston has a mayor-council form of government. Voters elect the mayor, 14 council members, and an official called the *controller* to two-year terms. The mayor serves as the city's chief executive and presides over City Council meetings as a voting member. The controller acts as the city's chief financial officer. Houston gets most of its tax revenue from property and sales taxes.

History

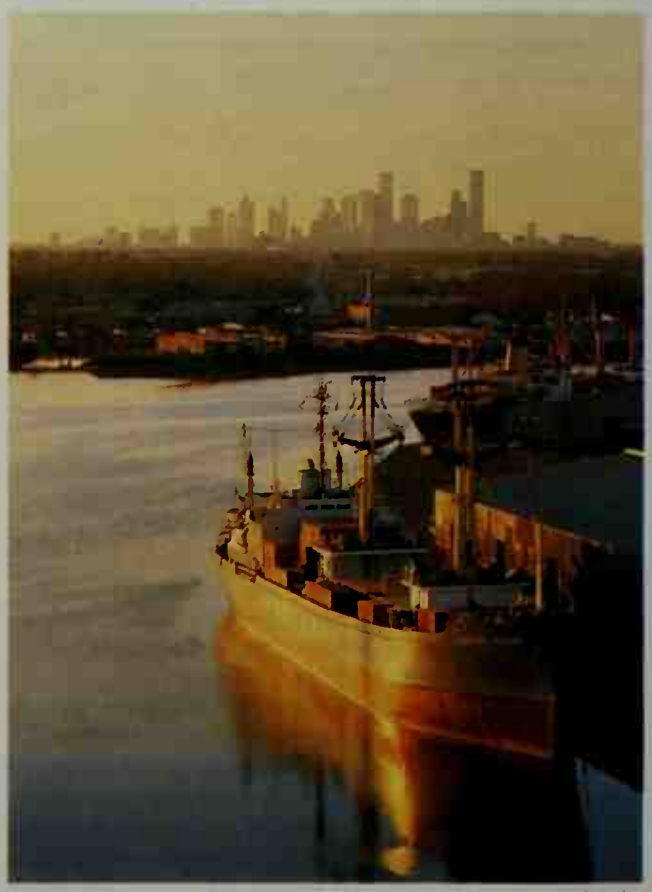
Early settlement. Before white settlers arrived, Karankawa Indians lived along the Gulf coast near what is now Houston. In 1836, two brothers, Augustus C. and John K. Allen, founded Houston. In 1837, the city was incorporated and became the capital of the Republic of Texas.

Commercial city. Houston's role as the capital of Texas helped the city grow. But in 1840, Austin became the capital. Houston then turned to shipping and commerce for its livelihood. The Port of Houston was established on Buffalo Bayou in 1841. Buffalo Bayou was too narrow and shallow for oceangoing ships. But barges and small steamboats carried cargo on the stream between Houston and the ocean port of Galveston. By 1850, Houston had 2,396 people. Railroads built during the 1850's linked Houston with other parts of Texas.

Several epidemics of yellow fever struck Houston in the mid-1800's. Nevertheless, the city's population rose to 9,332 by 1870. Houston's economy was aided by a huge surge in cotton production in Texas between 1870 and 1890. The city's location and transportation facilities helped it become a leading market for cotton and other agricultural products.

During the late 1800's, workers began building the Houston Ship Channel by widening and deepening Buffalo Bayou. In the early 1900's, city officials used federal and city funds to continue the project. In 1914, the Houston Ship Channel opened.

Petroleum capital. By 1900, the population of Houston reached 44,633. The discovery of oil in east Texas in the early 1900's accelerated Houston's growth. With its transportation network in place, Houston became a major distribution center for oil in the United States. By



Peter Gonzalez

The Port of Houston, on the Houston Ship Channel, is one of the busiest ports in the United States. Ships carry cargo between the port and other seaports around the world.

1930, Houston had become the largest city in Texas, with a population of 292,352.

Rapid industrial expansion during and after World War II (1939-1945) brought thousands of new residents to Houston. The city's population soared from 384,514 in 1940 to 938,219 in 1960. During this period, Houston jumped from 21st to 7th in population among U.S. cities.

In 1964, NASA's space center in Houston became the headquarters for the U.S. piloted space program. In 1969, the center's Mission Control directed the first landing of astronauts on the moon.

Houston's oil boom between 1973 and the early 1980's caused a rush of economic prosperity and further growth to the city. By 1980, Houston had become the fifth largest U.S. city, with 1,595,138 inhabitants.

Recent developments. During the 1980's, the city plunged into an economic recession brought on by a decline in oil prices. City leaders worked to bring greater variety to the economy to make Houston less dependent on oil. The economy improved during the 1990's. By 1990, Houston had become the fourth largest city of the United States. The population increased from 1,630,553 in 1990 to 1,953,631 in 2000. In 1997, Lee P. Brown was elected Houston's first African American mayor. He was reelected in 1999 and 2001.

Clifford L. Egan

Related articles in *World Book* include:

Baker, James A., III
Bush, George H. W.
Houston, Sam
Johnson Space Center
Jordan, Barbara C.
Texas (pictures)

Outline

- **I. The city**
  - A. Layout of Houston
  - B. Landmarks
  - C. Metropolitan Houston
- **II. People**
  - A. Ethnic groups
  - B. Housing
  - C. Education
  - D. Social problems
- **III. Cultural life**
  - A. The arts
  - B. Museums and libraries
  - C. Recreation
- **IV. Economy**
  - A. Manufacturing
  - B. Transportation and communication
- **V. Government**
- **VI. History**

Questions

How does Houston rank in population among U.S. cities?
Houston is named after what person? What did he do?
What are some of Houston's major problems?
The Houston Ship Channel links Houston to what body of water?
What are the sources of most of Houston's tax revenue?
Which Houston museum was the first art museum in Texas?
What are some of Houston's main manufacturing industries?
When was the Port of Houston established on Buffalo Bayou?
What are some of the activities of the Johnson Space Center?

Houston, *HYOO stuhn,* **Sam** (1793-1863), played a leading part in Texas's fight for independence from Mexico. He later served as president of the Republic of Texas and, after Texas joined the Union, as United States senator and governor of the state.

Samuel Houston was born on March 2, 1793, in Virginia. His family moved to Tennessee when he was 13. They lived in a frontier settlement, and Houston worked as a clerk in a store. When Houston was about 15, he ran away from home. He lived with the Cherokee Indians in Tennessee and was adopted into the tribe.

After nearly three years with the Indians, Houston returned to the white settlements and opened a country school. He enlisted in Andrew Jackson's army in the war against the Creek Indians, and he was wounded in battle.

Visual Instr. Bur., Univ. of Tex.

Sam Houston

Houston resigned from the U.S. Army in 1818. He then studied law and began to practice in Lebanon, Tennessee. Shortly after beginning his law practice, Houston was elected district attorney for the Nashville district. In 1823, he was elected to Congress. He was well liked there, though he made few speeches. Four years later, Houston became governor of Tennessee.

In 1829, Houston's wife left him, and he resigned as governor. He moved to Arkansas, where he lived with Cherokee Indians, and later to Nacogdoches, Texas. Texas was then a part of Mexico. But in 1836, the Americans who had settled in Texas sought separation from Mexico. Houston became one of their leaders. In 1836, he organized a Texas army and became its commander in chief. Houston led his troops in battles against forces of Mexican general Antonio López de Santa Anna. Houston won his greatest victory in the Battle of San Jacinto in April 1836. He captured Santa Anna, and the Mexican commander recognized the independence of Texas. In October, Houston was elected the first president of the new Republic of Texas. He served as its president until 1838. Houston served again from 1841 to 1844.

Houston worked to have Texas admitted to the United States. He succeeded in 1845, and from 1846 to 1859 he served as United States senator from Texas. He disagreed with the other Southern statesmen in the disputes leading to the American Civil War (1861-1865). Houston firmly opposed a break in the Union. In 1859, he ran for governor of Texas on an antisecession platform and won. But in 1861, Texas voted to secede. Houston refused to take Texas out of the Union, and Confederates removed him from the governorship. Houston then retired to private life. He died in Huntsville, Texas.

A statue of Houston represents Texas in Statuary Hall in Washington, D.C. The city of Houston is named in his honor. A fort in San Antonio also bears his name.

Joseph A. Stout, Jr.

See also San Jacinto, Battle of.

Additional resources

Fritz, Jean. *Make Way for Sam Houston.* 1986. Reprint. Putnam, 1998. Younger readers.
Williams, John H. *Sam Houston.* Simon & Schuster, 1993.

Hovercraft. See Air cushion vehicle.

Hovhaness, *HOHV uh nehs,* **Alan** (1911-2000), was an American composer. He became known for works that reflect his Armenian ancestry and his interest in Asian music. Hovhaness composed several hundred works, most of them instrumental, each lasting less than 20 minutes. His instrumental music includes over 60 symphonies as well as concertos and chamber music. He also wrote operas and music for solo instruments and

voices. Most of his orchestra works feature up-and-down sliding string passages with the range frequently indicated but not the exact notes.

Hovhaness incorporated traditional Armenian songs and dance music in *Armenian Rhapsody No. 1* (1944) and other compositions. His interest in the music of India appears in *Varuna* (1973), a string trio; and *Shambala* (1967), a concerto for violin, sitar, and orchestra. The influence of Japanese music can be heard in *Fantasy on Japanese Woodprints* (1965) for xylophone and orchestra. He used taped sounds of the humpback whale in *And God Created Great Whales* (1970) for orchestra. Hovhaness was born in Somerville, Massachusetts. Richard Jackson

Howard, Catherine. See Henry VIII.

Howard, Henry. See Surrey, Earl of.

Howard, John (1726?-1790), a British prison reformer, was apprenticed to a London grocer as a young man and inherited a fortune at the age of 25. He built model cottages for his workers, but did not begin his major work until his appointment as High Sheriff of Bedfordshire in 1773. In this job, shocked by what he found in prisons, he began a monumental study called *The State of the Prisons in England and Wales* (1777). It led Parliament to correct many abuses.

To keep his study up to date, Howard visited every prison in the country four times. He also visited prisons and plague hospitals throughout Europe, measuring rooms, inspecting kitchens, and talking with inmates. He died while on a tour of military hospitals in Russia.

Howard spent his entire fortune on his work. He was born in London. The John Howard Association, a U.S. prison-reform group founded in 1901, was named after him. A similar group in the United Kingdom is called the Howard League for Penal Reform. Alan Keith-Lucas

See also John Howard Association.

Howard, John Winston (1939-), became prime minister of Australia in 1996. He led a *coalition* (combination) of the National and Liberal parties to victory in general elections in 1996, 1998, and 2001.

Howard has supported policies aimed at reducing the bargaining power of labor unions and at decreasing government control over the economy. He opposes making Australia a republic, which would involve replacing the British monarch with a president as Australia's head of state. In addition, Howard favors closer links with Australia's traditional allies, especially the United Kingdom and the United States.

Howard was born in Sydney. He received a bachelor of laws degree from Sydney University in 1961. He joined the Liberal Party in 1958 and was elected to the federal House of Representatives in 1974. Howard served as minister for business and consumer affairs in 1976 and 1977 and as federal treasurer from 1977 to 1983. He was elected deputy leader of the Liberal Party in 1982 and leader in 1985. He lost the party leadership in 1989 but was reelected leader in 1995. Hugh V. Emy

Howard, Sidney (1891-1939), was a playwright who helped bring social drama to maturity in the United States. He was a master of play construction and characterization. His works show tolerance, a zest for life, and the need for freedom through responsibility.

Howard won fame for *They Knew What They Wanted* (1924), a Pulitzer Prize-winning drama of how an elderly husband and his young wife come to terms with life. His strongest play, *The Silver Cord* (1926), is a Freudian drama about a mother's excessive love for her son. *Alien Corn* (1933) is the story of an artist in a hostile community. *Yellow Jack* (1934) describes the battle against yellow fever. *Dodsworth* (1934) is based on Sinclair Lewis's satiric novel of American business. Howard wrote several film scripts, winning an Academy Award for his screenplay for *Gone with the Wind* (1939). He was born in Oakland, California. Frank R. Cunningham

Howard University, in Washington, D.C., is the largest predominantly African American university in the United States. It is a private, coeducational institution made up of 17 schools and colleges and 18 major research centers and institutes. It grants bachelor's, master's, and doctor's degrees and offers professional degrees in such areas as law, medicine, dentistry, religion, engineering, architecture, and social work.

Howard University's Moorland-Spingarn Research Center houses a large collection of materials documenting the history of people of African descent. The university publishes the *Journal of Negro Education* and the *Journal of Religious Thought.* Special facilities include a commercial radio station, a public television station, and the Howard University Press. Howard also has one of the largest laser chemistry laboratories in the United States. The university was founded in 1867 to educate newly freed slaves and their descendants.

Critically reviewed by Howard University

Howe, Elias (1819-1867), an American inventor, constructed a practical sewing machine. He patented it in 1846. Howe's sewing machine symbolized the important role in American industry of increasing mechanization during the 1800's.

Howe was born in Spencer, Massachusetts. As a young man, he went to Boston to learn the machinist trade. While apprenticed to a scientific-instrument maker in Cambridge, he overheard a remark that the person who made a workable sewing machine would make a fortune. In 1845, he finished a machine that sewed 250 stitches a minute, but he could not find a market for it.

Howe went to England and sold British rights to the machine. He returned to the United States in 1849. While Howe was in England, others, including Isaac Singer, started manufacturing sewing machines. After a long campaign, Howe established in 1854 his right to collect royalties on all machines manufactured.

Richard F. Hirsh

See also **Sewing machine** (History).

Howe, Gordie (1928-), was one of the greatest scorers in the history of the National Hockey League (NHL). A right wing, Howe scored 801 goals during his 26 seasons in the NHL, a league record until Wayne Gretzky broke it in 1994. Howe's career mark of 1,850 points (goals plus assists) was also an NHL record until Gretzky broke it in 1989. Howe led the league in goals five times and in points six times.

Howe played with the Detroit Red Wings from the 1946-1947 season through the 1970-1971 season. He won the Hart Memorial Trophy as Most Valuable Player in the NHL six times. After sitting out two years in retirement, Howe played with the Houston Aeros of the World Hockey Association (WHA) from the 1973-1974 season through the 1976-1977 season. His sons Mark and Marty were also members of the team. The Howes

joined the New England Whalers of the WHA for the 1977-1978 season. Gordie Howe remained with the team when it entered the NHL in 1979 as the Hartford Whalers. He retired after the 1979-1980 season at age 52.

Gordon Howe was born in Floral, Saskatchewan. He was inducted into the Hockey Hall of Fame in 1972.

Larry Wigge

Howe, Joseph (1804-1873), was a political leader and newspaper editor in the Canadian colony of Nova Scotia. Largely because of Howe's efforts, Nova Scotia became the first completely self-governing colony in the British Empire.

Howe was born in Halifax, Nova Scotia. From 1828 to 1841, he owned and edited the *Novascotian,* a Halifax newspaper that supported economic development and political reform. Howe was a member of the Legislative Assembly of Nova Scotia from 1836 to 1851. In the Assembly, he promoted self-government for Nova Scotia. Nova Scotia became self-governing in 1848. Howe served as premier of the colony from 1860 to 1863.

Howe led an unsuccessful effort to block Nova Scotia's entry into the Dominion of Canada, a union of Canadian colonies formed in 1867. He objected chiefly because the colony's membership was approved by the Nova Scotia legislature without a vote by Nova Scotians.

In 1869, Howe joined the Cabinet of Sir John A. Macdonald, Canada's first prime minister, as president of the Privy Council. Macdonald made him secretary of state for the Canadian provinces later that year. Howe became lieutenant governor of Nova Scotia in 1873.

Judith Fingard

Howe, Julia Ward (1819-1910), an American writer, lecturer, and reformer, was one of the most famous women of her time. She wrote the words of "The Battle Hymn of the Republic" and introduced the idea of Mother's Day.

Howe was born in New York City into a prominent family. She married American social reformer Samuel Gridley Howe in 1843 and moved to Boston. She wrote poems and plays and helped her husband edit *The Commonwealth,* an antislavery paper.

In 1861, during the American Civil War, Howe visited military camps near Washington, D.C. There she wrote "The Battle Hymn of the Republic" to be sung to the tune of the popular American song "John Brown's Body." It was published in the *Atlantic Monthly* two months later and became the major war song of the Union forces.

After the war, Howe became increasingly interested in the women's movement. In 1868, she helped organize the New England Woman's Club and served for many years as its president. Howe also became the first president of the New England Woman Suffrage Association.

After her husband's death in 1876, Howe became a frequent lecturer and writer on literary topics as well as on women's rights. Her writings include *A Trip to Cuba* (1860), *Sex and Education* (1874), *Modern Society* (1881), *Margaret Fuller* (1883), and *Reminiscences* (1899). In 1908, she became the first woman elected to the American Academy of Arts and Letters.

Brown Bros.

Julia Ward Howe

June Sochen

See also Battle Hymn of the Republic; Mother's Day.

Additional resources

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Grant, Mary H. *Private Woman, Public Person: An Account of the Life of Julia Ward Howe from 1819 to 1868.* Carlson Pub., 1994.

Williams, Gary. *Hungry Heart: The Literary Emergence of Julia Ward Howe.* Univ. of Mass. Pr., 1999.

Howe, Richard (1726-1799), Earl Howe, was a famous British naval officer who fought in the Revolutionary War in America. He joined the British Navy at the age of 14 and rose steadily in rank. At the start of the war in 1775, he was made vice admiral. The next year, he took command of the British fleet in America.

At the end of the war, Howe became First Lord of the Admiralty. When England and France went to war in 1793, he took command of the Channel Fleet. The next year, he won the victory known as "the glorious first of June," and King George III made him a Knight of the Garter. Howe became Admiral of the Fleet in 1796.

Howe was born in London. His brother William Howe became commander of the British Army in America during the Revolutionary War.

Philip Dwight Jones

Howe, Samuel Gridley (1801-1876), was an American social and political reformer. He went to Greece in 1824 to help the Greeks fight a war against the Ottoman Empire. He served in Greece as a soldier and surgeon and helped give relief to the war-torn people. Howe returned to Boston, his hometown, in 1830. In 1832, he became the first director of the New England Institution for the Education of the Blind (now Perkins School for the Blind), the first such institution in the United States. Howe directed the school for the rest of his life.

Howe also helped fellow reformer Horace Mann in Mann's fight for better public schools, and Dorothea Dix in her campaign to improve conditions in mental hospitals. Howe and his wife, Julia Ward Howe, edited *The Commonwealth,* an antislavery newspaper. Howe also helped rescue fugitive slaves and raised money to keep Kansas from becoming a slave state. He served in the federal government both during and after the American Civil War. Howe was born in Boston.

June Sochen

Howe, William (1729-1814), Viscount Howe, commanded the British Army in America during the early years of the Revolutionary War in America. In June 1775, he led the British in the Battle of Bunker Hill and, in October of that year, succeeded General Thomas Gage as commander of the British Army in America. Howe won the battles of Long Island, White Plains, and Brandywine, and occupied Philadelphia. But he did not defeat the Americans. As a result, he resigned his post and was succeeded by Sir Henry Clinton in 1778.

Howe was educated at Eton College. During the French and Indian War (1754-1763), he fought at the siege and capture of Louisbourg and in the Battle of Quebec (see **Quebec, Battle of**). Howe was knighted in 1776 and was made a general in 1793. His brother Richard Howe commanded the British fleet in America during the Revolutionary War.

Paul David Nelson

See also Revolutionary War in America.

Howells, William Dean (1837-1920), was an American fiction writer, editor, and critic. He discouraged artificial sentimentality and romanticism in American fiction. He also played an important part in the rise of the Realism movement in the United States (see **Realism**).

Howells was born on March 1, 1837, in Martins Ferry, Ohio. In 1861, President Abraham Lincoln appointed him U.S. consul in Venice, Italy, as a reward for writing a campaign biography of Lincoln in 1860. Howells lived in Venice until 1865 and described his experiences there in his first important work, *Venetian Life* (1866). In 1866, he began working for *The Atlantic Monthly* magazine in Boston. He was *The Atlantic*'s editor from 1871 to 1881.

Howells wrote his best novels after he left *The Atlantic*. Each of these novels deals with various issues of the day in an increasingly Realistic manner. *A Modern Instance* (1882) concerns the then-daring subjects of divorce and the loss of religious faith. *The Rise of Silas Lapham* (1885) is generally considered Howells's finest work. It describes the economic ruin but moral salvation of an ethical businessman in a Boston society controlled by families who inherited positions of power. *A Hazard of New Fortunes* (1890) portrays urban problems of New York City caused by industrialization, immigration, and clashes between socialism and capitalism.

Howells produced more than 40 novels and story collections, but his influence as an editor and critic was perhaps even greater than as a fiction writer. As editor of *The Atlantic,* he helped introduce European writers—especially leading Realists—to American readers. He challenged American authors to choose American subjects, to portray them honestly, and to create characters who used native American speech.

Howells also wrote columns in *Harper's New Monthly Magazine* (later *Harper's Monthly Magazine*) called the "Editor's Study" (1886-1892) and the "Editor's Easy Chair" (1900-1920). In these columns, he campaigned for literary Realism that examined life with scientific detachment. He helped introduce and support such Realistic writers as Mark Twain, Hamlin Garland, and Stephen Crane. The letters exchanged by Howells and Twain form one of the major collections of literary correspondence in American literature. Alan Gribben

Additional resources

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Howler is a type of large monkey noted for the exceptionally loud sound that it makes. A howler's roar can be heard as far as 2 miles (3.2 kilometers) away. Howlers roar at dawn to announce their location. They also roar when they are disturbed or when two groups of howlers meet. Howlers live in groups that generally have 15 to 20 members, but a group may have as few as 2 or as many as 45 monkeys. Howlers inhabit tropical forests from southern Mexico to southeastern Brazil. They live almost exclusively in trees.

Howlers weigh from 12 to 20 pounds (5.4 to 9 kilograms) and grow about 2 feet (60 centimeters) long. Their long, powerful tails may also measure 2 feet. Various species have black, brown, or reddish fur.

Howlers move slowly through trees while eating. They eat leaves, flowers, fruits, and nuts, using their hands to grasp branches or stems from which they nibble. They often swing by their tails while feeding. See **Animal** (picture: Animals of the tropical forests).

Randall L. Susman

Scientific classification. Howlers are in the New World monkey family, Cebidae. They make up the genus *Alouatta.*

Hoxha, *HAW jah,* **Enver** (1908-1985), established a Communist government in Albania in 1944 and ruled the country until his death. He strongly supported the policies of Joseph Stalin, dictator of the Soviet Union. Hoxha also kept Albania politically and socially isolated from nearly all other countries. These policies severely restricted individual freedom in Albania and helped keep it the poorest country in Europe.

In the late 1950's, Hoxha began to criticize the Soviet Union for its policy of peaceful coexistence with non-Communist countries. Albania and the Soviet Union broke diplomatic relations in 1961, and Albania became an ally of China. In 1978, Hoxha split with China after China had begun to improve its relations with non-Communist countries. Hoxha was born on Oct. 16, 1908, in Gjirokastër, Albania. Stuart D. Goldman

Hoyle, Edmond (1672-1769), was an English teacher of whist, a card game like bridge. In 1742, he published *A Short Treatise on the Game of Whist, containing the Laws of the Game.* Later, he added rules on other card games and on backgammon and chess. His book became so famous that the expression *according to Hoyle* came to mean *according to the rules of the game,* or *in the proper way.* R. Wayne Schmittberger

Hsi Chiang. See **Xi Jiang.**

Hsun-tzu. See **Xunzi.**

Hu Yaobang, *hoo yow bahng* (1915-1989), also spelled *Hu Yao-pang,* was head of China's Communist Party from 1981 to 1987. The party controls China's government. At the time, however, China's most powerful leader was Deng Xiaoping (see **Deng Xiaoping**).

Hu Yaobang was born in Hunan province. He joined the Communist Party in 1933. In the 1940's, Hu served in the political department of China's rebel Communist army and became a friend of Deng. Hu became head of the Communist Youth League in 1952. He was removed from office during China's Cultural Revolution (1966-1969). In 1973, Hu became an aide to Deng, then one of China's top leaders. In 1976, Deng and his associates, including Hu, were stripped of power.

Deng returned to power in 1977 and soon became China's top leader. He used his influence to help Hu rise in the party. In 1981, Hu, then general secretary, was also appointed chairman, the party's highest post.

In 1982, the party abolished the position of chairman and made the general secretary the top leader. Hu remained general secretary. In January 1987, he was removed from office. Conservative leaders had criticized Hu for his liberal views on freedom of expression. These views made Hu popular with citizens who wanted increased freedom. Hu's death in April 1989 helped trigger protests for more freedom. Hundreds of protesters were killed by the Chinese military (see **China** [Protests]).

Donald W. Klein

Huang He, *hwahng hu,* also spelled *Huang Ho,* is the second longest river in China. Only the Yangtze is longer. The Huang He is sometimes called *China's*

Sorrow because of the many floods that have brought hunger and death to the people living along its banks. The river is called *Huang He* (Yellow River) because it carries large amounts of soft yellow earth.

The Huang He runs a course of 3,000 miles (4,830 kilometers) and drains an area of about 400,000 square miles (1,036,000 square kilometers). It flows east from Qinghai Province to the Yellow Sea. The earth carried by the river is deposited in such large amounts at the river's bottom that it raises the bed and causes the river to change its course often. The Huang He cannot be used by ships because the upper part is too swift, while the middle and lower parts are too shallow.

The worst Huang He flood occurred in 1887, when the river overflowed an area of about 50,000 square miles (130,000 square kilometers). Nearly a million people died in this flood. Dikes have been kept up for hundreds of years to lessen the danger, but the river has never been completely controlled. James A. Hafner

See also **Flood** (River floods); **China** (terrain map).

Hubble, Edwin Powell (1889-1953), was an American astronomer. His studies of galaxies helped explain the structure, size, and evolution of the universe.

Hubble was the first astronomer to show that the universe contains star systems other than our galaxy, the Milky Way. He identified certain stars in the Andromeda Nebula as being of the same type as some stars in the Milky Way. But he also showed that Andromeda's stars were beyond the calculated boundaries of our galaxy and that Andromeda was therefore a separate galaxy.

Hubble later determined that all galaxies beyond the Milky Way are moving away from the earth. From this observation, he concluded that the universe is expanding. He also discovered that the galaxies that are farther from the earth recede faster than those that are nearer.

Hubble was born in Marshfield, Missouri, on Nov. 20, 1889. He earned a Ph.D. degree in 1917. In 1919, he joined the staff of the Mount Wilson Observatory in California, where he did most of his work as an astronomer.

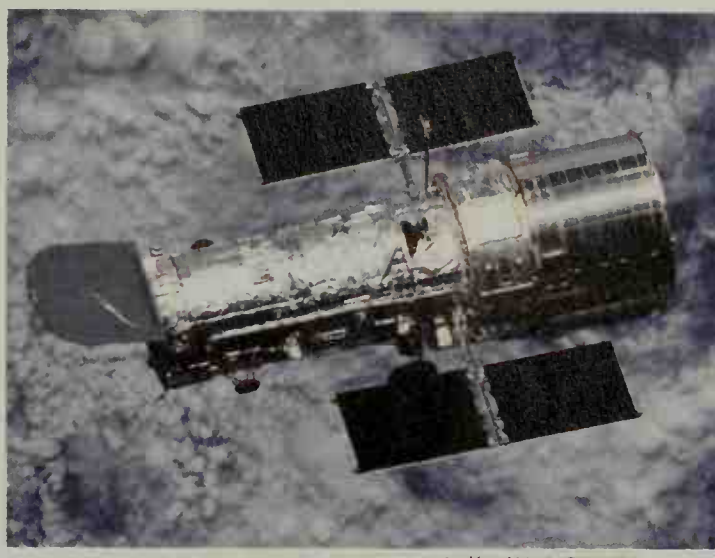
C. R. O'Dell

See also **Astronomy** (picture: Edwin Hubble).

Hubble Space Telescope is a powerful orbiting telescope that provides sharper images of heavenly bodies than other telescopes do. It is a reflecting telescope with a light-gathering mirror 94 inches (240 centimeters) in diameter. The telescope is named after American astronomer Edwin P. Hubble, who made fundamental contributions to astronomy in the 1920's.

Astronomers have used the Hubble Space Telescope to obtain images of celestial objects and phenomena in detail never before observed. These include pictures of stars surrounded by dusty disks that might someday evolve into planetary systems, images of galaxies on the edge of the observable universe, pictures of galaxies colliding and tearing each other apart, and evidence suggesting that most galaxies have massive black holes in their center.

How the telescope works. In orbit about 380 miles (610 kilometers) above the earth, the Hubble Space Telescope views the heavens without looking through the earth's atmosphere. The atmosphere bends light due to a phenomenon known as *diffraction*, and the atmosphere is constantly moving. This combination of diffraction and movement causes starlight to jiggle about as it



Lockheed Martin Corporation

The Hubble Space Telescope, an orbiting observatory launched in 1990, circles Earth high above the atmosphere.

passes through the air, and so stars appear to twinkle. Twinkling blurs images seen through ground-based telescopes. Because an orbiting telescope is above the atmosphere, it can produce pictures in much finer detail than a ground-based telescope can.

The Hubble Space Telescope can also observe ultraviolet and infrared light that is blocked by the atmosphere. These forms of light, like visible light, are electromagnetic radiation. The *wavelength* (distance between successive wave crests) of ultraviolet light is shorter than that of visible light. Infrared light has longer wavelengths than visible light. Ultraviolet light comes from highly energetic processes, such as the formation of disks around black holes and exploding stars. Infrared light provides information about cooler, calmer events, such as the formation of dust clouds around new stars.

The United States space agency, the National Aeronautics and Space Administration (NASA), operates the Hubble Space Telescope in cooperation with the European Space Agency (ESA). The telescope is controlled by radio commands relayed from NASA's Goddard Space Flight Center in Greenbelt, Maryland. Astronomers tell the telescope where to point, and computer-driven instruments aboard the telescope record the resulting observations. The telescope transmits the data by radio to astronomers on the ground.

The Hubble Space Telescope has two kinds of instruments: (1) imagers, which take pictures; and (2) spectrographs, which analyze light. Imagers are electronic detectors called *charge-coupled devices* (CCD's). The CCD's convert light into electronic signals, which an on-board computer records and sends to the ground.

A spectrograph, like a prism, spreads light into its component colors, much as water droplets spread sunlight into a rainbow. The resulting band of light is called a *spectrum* (plural *spectra*). Using spectrographic data from the Hubble Space Telescope, astronomers can determine the composition of stars and galaxies—measuring, for example, the amounts of hydrogen, carbon, and other chemical elements in them.

History. The space shuttle Discovery launched the telescope into orbit in 1990. Soon after launch, engi-

neers discovered a flaw in the telescope's light-gathering mirror. The flaw made the images less clear than they otherwise would have been. Engineers designed an optical device to bend light reflected by the mirror in a way that would make up for the error. Astronauts from the space shuttle Endeavour installed the device on the telescope in 1993, and it worked as planned.

During the 1993 mission, astronauts also mounted new instruments on the telescope. As part of a continuing program to upgrade the telescope, astronauts installed additional components in 1997, 1999, and 2002. The components installed in 2002 included new panels of *solar cells,* devices that convert sunlight to electric energy for use by the telescope. The new panels are two-thirds the size of the old panels, but 30 percent more efficient. Cecilia Barnbaum

See also Exploration (picture); **Hubble, Edwin P.; Telescope.**

Huckleberry is a small, round fruit that grows on a shrub. Huckleberries are black, blue, or red and contain many hard seeds. They ripen in late summer and are used in pies and jams.

Huckleberry plants grow 2 to 13 feet (0.6 to 4 meters) tall and sprout white, greenish-white, red, or reddish-green flowers.

WORLD BOOK illustration by Stuart Lafford, Linden Artists Ltd.

Black huckleberry

The most common huckleberries are *black huckleberries.* They grow wild across eastern North America. They thrive in partly shaded areas in peaty or sandy soil. *Blue huckleberries,* the sweetest type, are found chiefly along the Atlantic Coastal Plain of the United States. They grow in moist, peaty soil. Blue huckleberries are nicknamed *tangleberries* or *dangleberries* because of their long, arching stalks. *Evergreen huckleberries,* also called *shot huckleberries,* are common along the Pacific coast of the United States and Canada. Florists use its leaves and branches. George Pinyuh

Scientific classification. Huckleberries belong to the heath family, Ericaceae. The scientific name for the black huckleberry is *Gaylussacia baccata;* the blue huckleberry, *G. frondosa;* and the evergreen huckleberry, *Vaccinium ovatum.*

Hudson, Henry (? -1611), was an English explorer and sea captain. He made four voyages in an attempt to discover a northern route between Europe and Asia. Hudson never found such a sea passage, but he sailed farther north than any previous explorer. He explored three North American waterways later named for him—the Hudson River, Hudson Bay, and Hudson Strait.

Northern voyages. Historians know nothing about Hudson's life except for the period of 1607 to 1611, when he made his four voyages. In 1607, the Muscovy Company, an English trading firm, hired Hudson to find a northern sea route to Asia. European merchants and geographers believed that a ship could reach Asia by sailing north, northeast, or northwest. They thought such a route would be shorter than any other. The Arctic had not been explored, and people did not know that ice blocked the area around the North Pole.

New York City Art Commission

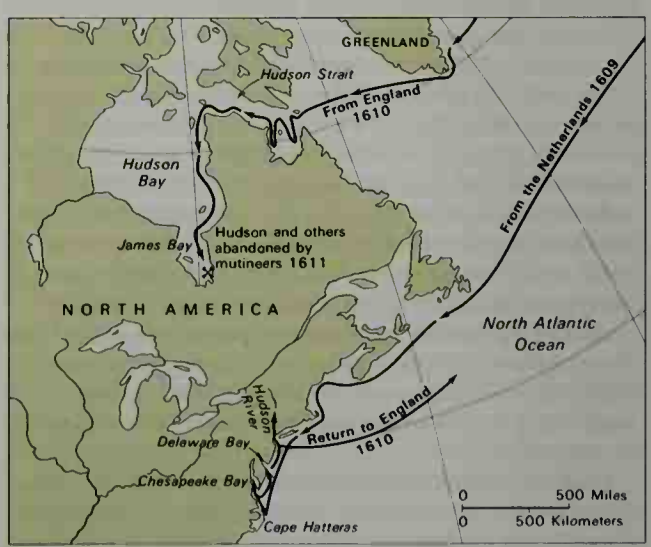
Henry Hudson

Hudson set out from England in a ship called the *Hopewell* with his young son, John, and a crew of 10 men. He sailed northeast along the coast of Greenland and reached Spitsbergen. These islands lie only about 700 miles (1,100 kilometers) from the North Pole, and no explorer had sailed so far north before. Huge ice floes forced Hudson to return to England. He told of seeing many whales in the northern waters, and his report led to English and Dutch whaling near Spitsbergen. In 1608, Hudson again tried to find a northern route, but ice again blocked the *Hopewell.*

North American voyages. The Muscovy Company lost interest in further northern exploration, but in 1609, the Dutch East India Company hired Hudson to lead an expedition. The company gave him a crew of about 20 men and a ship, the *Half Moon.* Hudson headed northeast, but his crew became unruly due to cold weather. Hudson changed his course for North America, crossed the Atlantic Ocean, and sailed down the east coast.

Hudson sailed as far south as what is now North Carolina. He then turned north and briefly explored Chesapeake Bay and Delaware Bay. Hudson traveled up what became known as the Hudson River to the site of present-day Albany, New York. Holland based its claims to land in North America on Hudson's third voyage.

In 1610, a group of English merchants formed a company that provided Hudson with a ship called the *Discovery.* He crossed the Atlantic and arrived just off the northern coast of Labrador. The *Discovery* then reached a body of rough water, later named Hudson Strait, that led into Hudson Bay.



WORLD BOOK map

Hudson's two North American voyages were organized in search of a passage to the Far East. On his last voyage, the crew mutinied and abandoned Hudson, his son, and others in James Bay. Hudsnn and his party were never found.

Hudson thought he had at last come to the Pacific Ocean, and he sailed south into what is now James Bay. But he failed to find an outlet at the south end of this bay. Ice forced the men to spend the winter there, and they suffered severely from cold, hunger, and disease.

In the spring of 1611, Hudson intended to search for a western outlet from James Bay. But the crew mutinied and set Hudson adrift in a small boat with his son, John, and seven loyal crewmen. Hudson and his party were never seen again. The mutineers sailed back to England, and their report gave continued hope that a passage existed between Hudson Bay and the Pacific. England based its claim to the vast Hudson Bay region on Hudson's last voyage. Exploration of the region led to the establishment in 1670 of the Hudson's Bay Company, a fur-trading firm. John Parker

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Hudson, William Henry (1841-1922), was a British author and naturalist. Hudson grew up in Argentina. Most of his books are reports of personal experiences in bird watching and nature study in the remote regions of South America. Hudson wrote these works in an intimate, semiautobiographical style. His best-known book is *Green Mansions* (1904), a romantic novel about a mysterious girl who lives in the jungles of South America.

Hudson was born to American parents in Quilmes, Argentina, near Buenos Aires. He settled in the United Kingdom about 1869 and became a British citizen in 1900. Hudson's first book, the novel *The Purple Land* (1885), and his autobiography, *Far Away and Long Ago* (1918), are vivid accounts of life in Argentina. Both helped familiarize European and North American readers with the landscape and history of South America. Avrom Fleishman

Hudson Bay is a vast inland sea in northeast Canada. It covers about 316,500 square miles (819,731 square kilometers), more than three times the combined area of the Great Lakes. The bay, together with its southern arm, James Bay, is about 1,050 miles (1,690 kilometers) long and 695 miles (1,118 kilometers) wide. It has an average depth of 330 feet (100 meters). Hudson Bay is part of the Arctic Ocean.

The land around the northern shore of the bay is part of a cold, flat, treeless area called a *tundra*. Forests grow to the south, and high, rocky bluffs rise on the east. In the west are flat, wet areas called *bogs*.

Shipping is the only important commercial activity on Hudson Bay. In most years, the shipping season lasts from mid-July to mid-October. The bay is largely free of ice during this period. Vessels enter and leave the bay through the Hudson Strait. They carry a variety of cargoes, including beef products and grain. Churchill, Manitoba, a grain-exporting center at the mouth of the Churchill River, is the main port on the bay. The Hudson Bay Railway links Churchill with the cattle and grain regions of western Canada. Although Churchill has only about 960 people, it is one of the largest communities on the bay. Only Puvirnituq, an Inuit village in Quebec, is larger. It has about 1,300 people.

WORLD BOOK map

Location of Hudson Bay

Inuit (formerly called Eskimos) and Indians were the first people who lived near Hudson Bay. Today, the Inuit live chiefly in small, widely separated communities in the tundra. Most of the Indians live on the southern end of the bay, near Churchill and James Bay. Many Inuit and Indians in the bay area work in construction or retail trade. Others work for government agencies. Still other Inuit and Indians fish and hunt for a living.

Hudson Bay was named for the English explorer Henry Hudson, who reached it in 1610. In 1670, English merchants founded the Hudson's Bay Company, which became one of the largest fur-trading companies in North America. The company eventually acquired full land and trading rights in the Hudson Bay area, which included the bay and all lands drained by rivers that flowed into the bay. In 1870, the Canadian government purchased this territory from the Hudson's Bay Company and made it part of Canada.

Little development occurred in the bay area until 1971. That year, the province of Quebec began to construct a group of hydroelectric stations on La Grande River, which flows into James Bay, as part of a major development project. The construction, which took place between 1971 and 1996, involved the building of 11 dams and 8 power stations. Robin B. Burns

See also **Hudson, Henry; Hudson's Bay Company; James Bay.**

Hudson River is a major United States waterway. New York City's harbor lies at its mouth. In 1609, English explorer Henry Hudson became the first European to sail up the river, which was later named for him. The Hudson is broad and flows through a beautiful valley. It is sometimes called *America's Rhine* because sections of its beautiful shores resemble the Rhine River in Germany. For location, see **New York** (physical map).

The Hudson is 306 miles (492 kilometers) long and lies almost entirely in the state of New York. For about 25 miles (40 kilometers), the river forms a boundary with New Jersey. The Hudson begins in the Adirondack Mountains, 4,313 feet (1,315 meters) above sea level. From there, the river flows southward near the eastern boundary of New York and empties into the Atlantic Ocean at New York City. The Hudson passes through Albany, New York, the capital of the state, and through

some of the state's other most populated areas.

The Hudson has two distinct sections. North of Troy, New York, the river has many rapids and waterfalls, which were once used to power textile and lumber mills. Near Troy, the Hudson enters a valley deepened by glaciers. South of this area, the river's bed lies below sea level and is subjected to tides from the Atlantic Ocean. Thus, oceangoing vessels can travel along the river as far north as the Troy-Albany area.

The Mohawk River is the largest branch of the Hudson. It joins the Hudson about 4 miles (6.4 kilometers) north of Troy. The U.S. Military Academy lies in a narrow, rocky, and scenic area of the Hudson River Valley known as Hudson Highlands. High, rocky cliffs called the Palisades rise along the New Jersey shoreline south of the Hudson Highlands.

During the 1600's, the Dutch became the first Europeans to settle in the Hudson River Valley. Henry Hudson had reached the river while in the service of Holland. The Hudson River Valley was an important military center during the French and Indian wars (1689-1763) and the Revolutionary War in America (1775-1783).

During the 1800's, European travelers journeyed along the Hudson, between Albany and New York City, to admire the Catskill Mountains to the west and the farms and magnificent estates along the eastern shore. Artists of the Hudson River School celebrated the Hudson and its valley. In 1802, the U.S. Military Academy was established on a bluff overlooking the Hudson.

Completion of the Erie Canal in 1825 made the Hudson one of the most important transportation passages in the United States. The canal linked the Troy-Albany area and Buffalo, New York, a gateway to the Great Lakes (see **Erie Canal**). New York City, at the river's mouth, became the country's chief port for foreign trade and immigration. Michael K. Heiman

See also **Fulton, Robert; George Washington Bridge; Hudson, Henry; Hudson River School; New York** (picture).

Hudson River School was the name of the first group of American artists to develop a characteristic style of landscape painting. The school flourished from 1825 until the late 1800's. The early artists of this group painted many scenes of the Hudson River Valley in New York. Later artists of the school painted landscapes of various areas of North and South America.

Before the 1800's, there was almost no tradition of landscape painting in America. Some Hudson River School paintings resembled the peaceful countrysides painted by many Europeans. But others showed the untamed beauty and the grandeur of canyons, rivers, and other natural features. These landscapes reflected the artists' pride in their country and their love of nature.

The Hudson River School first became known in 1825. That year, the landscapes of Thomas Cole gained popularity. The originality and directness of Cole's works impressed many artists, and he became a leader of the Hudson River group. Other artists who helped the school develop included Thomas Doughty and Asher B. Durand. Later artists included Albert Bierstadt, Frederick E. Church, Jasper F. Cropsey, John F. Kensett, and Thomas Moran. Sarah Burns

See also **Bierstadt, Albert; Church, Frederick E.; Cole, Thomas.**

Hudson River tunnels provide links between Manhattan Island and New Jersey. Manhattan, the heart of New York City, is separated from New Jersey on the west by the broad Hudson River. The tunnels run under the Hudson.

As late as the year 1900, Manhattan was not connected with New Jersey by either bridge or tunnel. A few bridges crossed the narrow Harlem River on the north, connecting Manhattan with the Bronx. Brooklyn Bridge, across the East River, connected the lower end of Manhattan with Long Island. But the thousands of New Jersey people who worked in Manhattan had to cross the Hudson River every day by ferryboat. This was the same method that the Dutch had used nearly 300 years before when they bought Manhattan Island from the Indians. Today, seven tunnels under the Hudson River connect Manhattan with New Jersey. The tunnels are used for rail, automobile, truck, and bus traffic.

The PATH tunnels are rapid transit tunnels. Two uptown tunnels run between Morton Street in Manhattan and Jersey City, New Jersey. Each is about 5,650 feet (1,750 meters) long. Two downtown tunnels, each about 5,280 feet (1,609 meters) long, extend between the World Trade Center in Manhattan and Jersey City. But these tunnels have been closed since the Manhattan station was destroyed in the collapse of the World Trade Center towers after a terrorist attack on Sept. 11, 2001. They are scheduled to reopen in 2003. The name *PATH* stands for the *P*ort *A*uthority *T*rans-*H*udson Corporation, which operates the tunnels. PATH is a subsidiary of the Port Authority of New York and New Jersey.

The uptown tunnels are the oldest of the Hudson

Oil painting on canvas (about 1840); the Metropolitan Museum of Art, New York City, Gift of Samuel P. Avery, 1895

The Hudson River School was a group of American landscape painters. Thomas Doughty, a leader of the school, painted *A River Glimpse,* which shows the Hudson River Valley.

River tunnels. The first attempt to dig one of them was made in 1874, but the work was stopped before it was finished. In 1902, a lawyer named William G. McAdoo raised money to complete the tunnel and to build a second one so two-way traffic could run under the river. McAdoo represented the Hudson and Manhattan Railroad Company. The uptown tunnels were opened to traffic in 1908. McAdoo also raised money to build the downtown tunnels, which opened in 1909.

Amtrak's Hudson River Tunnel, which opened in 1910, connects Pennsylvania Station in Manhattan with Newark, New Jersey. It is used by passenger trains traveling between New York and the South and West. It has two tubes and is 13,400 feet (4,100 meters) long. Amtrak operates the tunnel.

The Holland Tunnel provides a direct link from Canal Street in Manhattan to Jersey City. It has two tubes more than 8,000 feet (2,400 meters) long, with two traffic lanes in each for automobiles, trucks, and buses. The tunnel, which is operated by the Port Authority of New York and New Jersey, was opened to traffic in 1927. The method and principles used in the design and construction of the tunnel still form the basis for building vehicular tunnels throughout the world.

The Lincoln Tunnel, also used by motor vehicles, provides a link between 38th Street in midtown Manhattan and Weehawken, New Jersey. The tunnel, operated by the Port Authority of New York and New Jersey, is the world's only three-tube underwater vehicular tunnel. Two of its tubes are over 8,000 feet (2,400 meters) long, and the third is about 7,500 feet (2,290 meters) long.

Each tube has two lanes for vehicular traffic. The center tube, used for eastbound, westbound, or two-way traffic as conditions require, opened in 1937. The north tube, for westbound traffic, opened in 1945. The south tube, used for eastbound traffic, opened in 1957.

Robert E. Paaswell

See also New York City (map).

Hudson's Bay Company is a business firm that became famous for its role in western Canadian history. It was founded in London in 1670 to establish a fur trade in what is now the Hudson Bay region. Today, Hudson's Bay Company is one of Canada's largest corporations.

Beginnings. A group of English merchants and nobles founded the Hudson's Bay Company with the help of two French fur traders, Sieur des Groseilliers and Pierre Esprit Radisson. The two traders knew that furs from North America could earn fortunes. After a quarrel with the French colonial government in Quebec over profits and taxes, they had offered their services to Charles II of England.

In 1668, Groseilliers helped direct a trading expedition to the Hudson Bay region. The expedition was so successful that the king gave the Hudson's Bay Company a charter in 1670. The firm received sole trading rights in all lands drained by the streams that flowed into Hudson Bay. Company agents built trading posts and forts along the bay. They traded with the Indians and exchanged such goods as guns, kettles, and knives for beaver pelts. In England, the pelts were made into expensive felt for garments and hats.

Growth and problems. For many years, the company struggled with the French, who also claimed the Hudson Bay region. French forces from Montreal and Quebec captured and destroyed many of the firm's trading posts. French fur traders began to threaten the company's trade monopoly with the Indians. But the British took control of almost all French lands in Canada in 1763, and the company gained almost complete control of the fur trade in the region.

Hudson's Bay Company

The Hudson's Bay Company contributed to Canada's settlement. This trading post in Ontario was photographed in 1886.

During the late 1770's and 1780's, the North West Company, a newly organized group of independent fur traders, began competing with the Hudson's Bay Company. Because of the growing competition, the Hudson's Bay Company sent expeditions far inland to find new sources of fur. Its explorers established a network of trading posts and transport routes. The Hudson's Bay Company thus helped open Canada to settlement all the way to the Pacific coast.

In 1821, the two rival companies combined under the name Hudson's Bay Company. This company was completely reorganized under the leadership of Sir George Simpson (see **Simpson, Sir George**). It held full land and trading rights in much of western British North America until 1870. That year, the company gave the British government much of the territory granted by its charter. The government, in turn, transferred the land to the newly formed Dominion of Canada. The company received about $1\frac{1}{2}$ million for the land from the Canadian government. It lost certain trading rights but kept large areas of the western plains. The Hudson's Bay Company later sold these lands to settlers.

Recent developments. The Hudson's Bay Company ended its fur-trading business in 1989. Today, it ranks as Canada's largest department store retailer. The company owns a chain of department stores throughout Canada.

John Elgin Foster

See also **Groseilliers, Sieur des; Radisson, Pierre E.**

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Hue, *hway* (pop. 362,696), is a city in central Vietnam. For the location of Hue, see **Vietnam** (map). Sand dunes

and shallow lagoons cut off Hue from the South China Sea. However, the land behind the dunes is flat and cultivated. The city is a center of student and religious life. The University of Hue was founded there in 1957.

Hue was the capital of Vietnam during the rule of the Nguyen dynasty in the 1800's. It continued as the royal capital until 1945. Palaces that were built in the Chinese style during the Nguyen period still stand in the city.

Hue became part of South Vietnam when that nation was formed in 1954. Communist forces gained control of Hue for several weeks in 1968 in one of the largest attacks on South Vietnam during the Vietnam War. The Communists won the war in 1975, and Hue and the rest of South Vietnam then came under the control of Communist North Vietnam. The Communists unified North Vietnam and South Vietnam into the single nation of Vietnam in 1976. David P. Chandler

Huerta, Dolores Fernandez (1930-), is an American labor union leader, lobbyist, and civil rights activist. She is known for her commitment to nonviolence and for her support of the rights of farmworkers, women, minority groups, and the poor. For more than 30 years, she worked closely with the California labor union leader Cesar Chavez to organize farmworkers.

Huerta was born Dolores Clara Fernandez in Dawson, New Mexico, on April 10, 1930. She went to high school in Stockton, California, and then attended a local community college. In the 1950's, she married Ventura Huerta, a public health administrator. They later divorced.

In the mid-1950's, she helped establish the Stockton chapter of the Community Service Organization (CSO). She was involved in campaigns to register people to vote and to improve services in the Mexican American community. Through her involvement with the CSO, Huerta met Cesar Chavez. In 1962, Huerta helped Chavez found the National Farm Workers Association (NFWA). In 1966, the NFWA merged with another union to create the United Farm Workers Organizing Committee. In 1972, the organization changed its name to the United Farm Workers of America (UFW).

As a UFW negotiator, Huerta assisted in the development of labor policies for hiring, *grievance* (complaint) procedures, and benefit plans. She also organized strikes and consumer boycotts. She was instrumental in the passage of the Agricultural Labor Relations Act (1974), which enabled farmworkers to bargain for better wages and working conditions. Louis M. Holscher

See also Chavez, Cesar Estrada; United Farm Workers of America.

Hufstedler, Shirley Mount (1925-), served from 1979 to 1981 as the first United States secretary of education. President Jimmy Carter appointed her to head the U.S. Department of Education, which develops and coordinates national educational policies and programs. Congress had established the Department of Education in 1979. The department began operating in 1980.

Hufstedler was born on Aug. 24, 1925, in Denver, Colorado. She graduated from the University of New Mexico and earned a law degree from the Stanford University School of Law. Hufstedler practiced law in Los Angeles until 1961, when she was appointed to the Superior Court of Los Angeles County. From 1966 to 1968, Hufstedler served as a justice of the California Court of Appeals. In 1968, President Lyndon B. Johnson appointed Hufstedler to the United States Court of Appeals in San Francisco. At that time, Hufstedler was the highest-ranking woman judge in the United States. William J. Eaton

Hugh Capet, *ka PEH* (940?-996), was king of France from 987 to 996. Three of his ancestors had been French kings during the 800's and 900's. Kings descended from Hugh ruled France without interruption from 996 until 1792 and again from 1814 to 1848. A line of French kings related to Hugh took its name from him and became known as the Capetian dynasty. This dynasty replaced the Carolingian family of French kings, who were descended from the great French ruler Charlemagne.

Hugh was head of an important family in northern France. The leading princes of France elected him king in 987. As king, Hugh had little power outside his ancestral lands. But in 987, he arranged to have his son Robert elected *king-designate,* or the king's successor. The next several kings designated their heirs in a similar way, and the French monarchy eventually became hereditary. John Bell Henneman

See also Bourbon; Capetian dynasty; Valois.

Hughes, Charles Evans (1862-1948), served as chief justice of the United States from 1930 to 1941. Hughes guided the Supreme Court during one of its most turbulent periods and is considered to have been one of the country's great chief justices.

During Hughes's early years as chief justice, the Supreme Court held many of President Franklin D. Roosevelt's New Deal laws to be unconstitutional (see **New Deal**). The court ruled the laws violated the rights of states and of property owners. Hughes resisted strongly when the president tried to "pack" the court with justices who supported the New Deal (see **Roosevelt, Franklin D.** [The Supreme Court]). But later, in response to pressure from the executive branch, Hughes led the court in overturning the earlier anti-New Deal rulings and in focusing more on the protection of civil rights and civil liberties. Hughes became well known for his opinions that upheld human liberties.

Hughes was born in Glens Falls, New York, on April 11, 1862. He graduated from Brown University and from Columbia University Law School. He attracted attention in 1905 when he was counsel for the New York legislative committees that investigated the gas industry and the insurance business. His fairness and thoroughness in exposing major scandals led to his election as governor of New York in 1906. He won a second term in 1908.

Hughes was appointed an associate justice of the U.S. Supreme Court in 1910. He resigned in 1916 to run for the presidency as a Republican but lost narrowly to President Woodrow Wilson. Hughes was secretary of state from 1921 to 1925. He initiated the Dawes Plan to relieve Germany of its crushing war debts after World War I (see **Dawes Plan**). In 1928, he became a judge of the World Court. President Herbert Hoover reappointed him to the Supreme Court in 1930. Bruce Allen Murphy

Hughes, Howard Robard (1905-1976), an American businessman, became known as one of the world's richest people. During the 1930's and 1940's, he gained fame as a motion-picture producer and aviator. Then, in the mid-1950's, Hughes deliberately dropped out of sight. He became a mysterious figure who never appeared in public and even refused to have his photograph taken.

Hughes was born on Dec. 24, 1905, in Houston. His fa-

ther died in 1924, leaving him the Hughes Tool Company, an oil-field equipment firm. The firm became the basis of Hughes's financial empire. He later owned the Hughes Aircraft Company, RKO Pictures Corporation, and a controlling interest in Trans World Airlines.

Hughes led a varied life. He became a Hollywood film producer after his father's death. His most successful movies included *Hell's Angels* (1930), *Scarface* (1932), and *The Outlaw* (1943). Hughes also designed and raced airplanes. He set several speed records, including an around-the-world mark of 3 days 19 hours 14 minutes. In the 1940's, he designed the plane that still holds the record for the largest wingspan of any plane ever built—319 feet 11 inches (97.57 meters). This eight-engine wooden flying boat, nicknamed *Spruce Goose,* had room for 700 passengers. In 1947, Hughes piloted the plane on its only flight. It flew 1 mile (1.6 kilometers) at a height of 70 feet (21 meters).

At the time of Hughes's death, estimates of the value of his estate went as high as $2 billion. But in 1984, the United States Internal Revenue Service and the states of California and Texas valued the estate at $380 million for taxation purposes. California and Texas worked out an agreement to share the inheritance taxes from the Hughes estate.

In 1971, the McGraw-Hill Book Company paid about $750,000 to Clifford Irving, a writer, for a manuscript he presented as Hughes's autobiography. Irving claimed he worked on it with Hughes, but Hughes denied knowing Irving. In 1972, Irving and his wife admitted to misrepresenting the manuscript to the publisher. They were fined and imprisoned. Bobby H. Johnson

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Hughes, Langston (1902-1967), was an African American author. He published works in all forms of literature, but he was best known for his poetry and his sketches about a black man called "Simple."

Most of Hughes's sketches about Simple have no plot. Simple expresses his opinions about current issues. He is outspoken, emotional, and impulsive. Hughes used Simple to indicate what an intelligent, but uneducated, proud black man might say if given the chance.

In his best-known poetry, Hughes wrote proudly and optimistically about black people. He experimented with poetic *meter* (rhythm), using the rhythms of black music in his poetry. The literary respect he earned probably influenced the metrical experiments of other African American poets during the 1960's. Hughes was also highly interested in drama. He wrote plays and established theatrical companies. His drama *Mulatto* (1935) had a long run of 373 performances on Broadway.

Hughes wrote or edited more than 50 books. Examples of his work are *Not Without Laughter* (1930), a novel; *The Ways of White Folks* (1934), a collection of short stories; *The Big Sea* (1940), an autobiography; *The Langston Hughes Reader* (1958); *The Best of Simple* (1961); and *Five Plays by Langston Hughes* (1963). *The Collected Poems of Langston Hughes* was published in 1994, after his death. James Langston Hughes was born on Feb. 1, 1902, in Joplin, Missouri. He graduated from Lincoln University in Pennsylvania. Nellie Y. McKay

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Hughes, Ted (1930-1998), was an English poet known for his violent and symbolic nature poems. Hughes was appointed poet laureate of England in 1984.

Hughes's first collection of poetry, *The Hawk in the Rain* (1957), portrays in powerful and descriptive language the beauty and brutality Hughes saw in nature. Hughes's reputation increased after he published a long cycle of lyrics dominated by a menacing bird called Crow. The bird is a composite symbol taken from several mythical and religious traditions. The Crow poems were published in five volumes in 1970 and 1971. The best-known work in the cycle is *Crow: From the Life and Songs of the Crow* (1970). Hughes continued his mythical themes in *Cave Birds* (1975). Hughes's later nature poems, beginning with *Moortown* (1980), carry a note of hope and affirmation absent from his earlier work.

Edward James Hughes was born on Aug. 16, 1930, in Mytholmroyd in West Yorkshire. The birds and other animals Hughes observed on the moors near his home influenced the content and imagery of his poetry. He was married to the American poet Sylvia Plath from 1956 until her suicide in 1963. He wrote about their relationship in a collection of 88 poems called *Birthday Letters* (1998). William Harmon

See also Plath, Sylvia.

Hughes, Thomas (1822-1896), was an English author. He is best known for his novel *Tom Brown's School Days* (1857), the earliest story about life in a British public school. He based the book on his experiences at Rugby School (see Rugby School). His next novel, *Tom Brown at Oxford* (1861), was less successful. He devoted himself to religious and political writing. He was active in the Christian Socialist movement and worked to improve conditions among the poor. He sponsored a short-lived settlement for poor English boys in Rugby, Tennessee. Hughes was born on Oct. 20, 1822, in Berkshire. Richard J. Dunn

Hugo, Victor Marie (1802-1885), a French author, led the romantic movement in French literature. His writings reveal his love of liberty, his sympathy with the suffering of ordinary people, and his understanding of the French language's expressive potential.

Early life. Hugo was born on Feb. 26, 1802, in Besançon. At age 17, he and his brothers founded a journal, *The Literary Conservative.* In 1822, Hugo married Adèle Foucher and published *Odes and Various Poems,* his first book of verse. These poems were written in a classical style and many of them supported the Bourbon monarchy. Hugo soon began frequenting a circle of young romantic writers. With the appearance of

Chicago Historical Society

Victor Hugo

Odes and Ballads (1826) and *The Orientals* (1829), he came into his own as a romantic poet.

In the preface to his historical play *Cromwell,* published in 1827, Hugo called for a break with the classical literary rules that had governed playwriting. This preface became a major document in romantic aesthetic theory. The premiere of his verse drama *Hernani* in 1830 sparked a revolution in French theater and established Hugo as the undisputed leader of the French romantic movement. In the following years, he wrote several plays, including *The King Is Amused* (1832) and *Ruy Blas* (1838). His novel *The Hunchback of Notre Dame* (1831) widened his fame. He also wrote a series of successful books of poetry, including *Leaves of Autumn* (1831), *Songs of Twilight* (1835), *Inner Voices* (1837), and *Rays and Shadows* (1840).

Political activity. During the 1840's, Hugo's creative writing diminished for a variety of reasons. In 1843, his play *The Burgraves* failed dismally. That same year, his oldest daughter, whom he adored, drowned with her husband. In addition, Hugo had developed political ambitions, which soon began to occupy his time.

By the time the Revolution of 1848 established the Second Republic in France, Hugo's political sympathies had shifted from monarchism to republicanism. He was elected to the new National Assembly. There he spoke for the expansion of voting rights, free education, and freedom of the press. At first, Hugo supported Louis Napoleon, president of the republic. But he opposed Louis when he saw that the president was becoming a tyrant.

Exile and return. In December 1851, Louis Napoleon overthrew the republic. He made himself dictator with the title Emperor Napoleon III. Hugo went into exile for almost 20 years. He lived first in Belgium and then on the island of Jersey in the English Channel. From 1855 to 1870, he lived on the channel island of Guernsey. In 1853, Hugo completed *The Chastisements,* a collection of satirical poems that denounced Napoleon III for destroying the Second Republic. In 1859, he rejected an opportunity to return to France. He declared that he would return only with the return of liberty.

While in exile, Hugo wrote much of his finest work. *The Contemplations* (1856) is a spiritual autobiography that recorded Hugo's development into a political leader and visionary poet. It contains some of his best lyric poetry. *The Legend of the Centuries* (1859, new sections added in 1877 and 1883) is a masterpiece of epic poetry. *Les Misérables* appeared in 1862.

Hugo became a symbol of freedom to French people during his exile. After the overthrow of Napoleon III in 1870, Hugo returned to France in triumph. He spent his final years celebrated by his fellow citizens as a champion of democracy and of the common people.

His works. During his life, Hugo gained his greatest popularity for his plays. In the United Kingdom and the United States, he became known chiefly as a novelist. The French today honor him especially for his poetry.

Throughout his life, Hugo composed epic, lyric, and satirical poetry. He often combined these types into individual collections or even single poems. *The Chastisements* includes elegies, fragments of epics, odes, and songs. Many poems in *The Contemplations* produce powerful visionary effects through the unusual treatment of metaphor, diction, and sound. *The Legend of the Centuries* traces humanity's historical and spiritual development from the Creation to the 1800's and into the future. Hugo ended the work by predicting a human destiny of continual material and moral progress.

In his plays, Hugo used many devices of melodrama, including complicated plots, multiple change of scenes, and intense expression of emotion. However, the plays rise above much popular theater of the time, particularly in their experimentation with the stage's visual and verbal potential and their moral and political message.

Hugo's novels appeal to many people because of their vivid re-creations of history and their treatment of moral issues through the actions of simple but unforgettable characters. *The Hunchback of Notre Dame* established Hugo as a master of the historical novel. The story takes place during the 1400's in Paris. It centers on Quasimodo, a deformed bell ringer, and on the Cathedral of Notre Dame itself. The novel *Ninety-Three* (1874) concerns the moral dilemmas raised by events of the French Revolution. *Les Misérables* is set in the France of Hugo's day. The hero, an escaped convict named Jean Valjean, struggles to lead an honest, useful life despite the prejudices of a cruel society. The novel reflects Hugo's faith in the individual's power of self-determination against overwhelming odds.

Hugo's reputation was challenged after his death by critics who accused him of expressing shallow ideas and having an overly instructive and sentimental style. Today, Hugo's works have found renewed interest because of his imaginative treatment of theme and innovative use of language and literary forms. Suzanne Nash

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Huguenots, *HYOO guh nahts,* were a group of Protestants who became the center of political and religious quarrels in France in the 1500's and 1600's. French Protestantism, though influenced by Martin Luther and French reformers of the early 1500's, was dominated by the teachings of John Calvin. Calvin was a French Protestant leader who headed the Reformed Church in Geneva, Switzerland.

King Francis I tolerated the Huguenots for much of his reign (1515-1547), which helped them grow. During the reign of Henry II (1547-1559), the Huguenots became a large and influential group. As they grew strong, the government persecuted them more and more. Such important people as Admiral Gaspard de Coligny and Anthony, king of Navarre, were Huguenots. The Guise family led French Roman Catholics and influenced Henry's son King Francis II against the Huguenots.

The massacre. After Francis II died in 1560 and Charles IX became king, the queen mother, Catherine de Médicis, dominated the government. For a time, she encouraged the Huguenots as a balance against the Guises. But feelings in both parties became so bitter that civil war broke out. The Huguenots had some of France's best military leaders and a well-organized army. Catherine, fearing Coligny's influence on her son, allied herself with Henry, the Duke of Guise. Some historians suspect but cannot prove that Catherine and Guise were

Detail of *Massacre of the Huguenots*, an oil painting by François Dubois (late 1500's); Musée Cantonal des Beaux-Arts, Lausanne, Switzerland

A massacre of Huguenots by pro-Catholic forces began in Paris on St. Bartholomew's Day in 1572. The massacre spread through France and thousands of Huguenots were murdered.

responsible for the Massacre of Saint Bartholomew's Day, which occurred in 1572. In the massacre, pro-Catholic forces murdered thousands of Huguenots.

Henry III, who succeeded Charles IX in 1574, feared the popularity of the Guise family and had the Duke of Guise and his brother, a cardinal, assassinated in 1588. These murders aroused public feeling against Henry, and he allied himself with Henry of Navarre and the Huguenots. In 1589, Henry III was assassinated, and Henry of Navarre, a Protestant, became king.

Most of France was Catholic, and Henry realized he must become a Catholic to be a successful king. But in 1598, Henry issued the Edict of Nantes, which gave the Huguenots freedom of worship in 100 communities. The edict also gave them much political independence. The Huguenots thus formed a sort of Protestant republic within the Catholic kingdom (see **Nantes, Edict of**).

Flight from France. The Huguenots lost their political independence under Louis XIII, who was king from 1610 to 1643, and his minister, Cardinal Richelieu. But they did not lose their freedom of worship until 1685, when Louis XIV repealed the Edict of Nantes. After the repeal, about 200,000 Huguenots fled to such places as the Netherlands, England, Brandenburg (now part of Germany), and America. Many Huguenots were craftworkers or textile workers, and they contributed to the prosperity of the countries where they settled. The Huguenots who remained in France regained their civil rights during the French Revolution (1789-1799).

Political outgrowth of the struggle. The struggle between Huguenots and Catholics in France contributed to the growth of freedom and democracy in Europe. Arguments for civil disobedience and rebellion against tyranny emerged among both groups. Some writers suggested that the source of political authority should not lie in a hereditary monarchy, but with the people. These ideas influenced English thought of the 1600's and, later, the American and French revolutions. Donald A. Bailey

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Henry IV (of France)
Richelieu, Cardinal
Saint Bartholomew's Day, Massacre of

Hui-tsung. See Huizong.

Huizinga, *HOY zihng ah,* **Johan,** *yoh HAHN* (1872-1945), was a noted Dutch historian. He was especially interested in portraying the spirit of an entire age or civilization. His fame rests on the range and quality of his writings, and his ability to capture the very flavor of life. Huizinga's most famous work, *The Waning of the Middle Ages* (1919), is a study of life in the Netherlands during the 1300's and 1400's.

Huizinga was born on Dec. 7, 1872, in Groningen, the Netherlands. He taught at universities in Groningen and Leiden. His major works include *In the Shadow of Tomorrow* (1935), a collection of essays on the cultural condition of people in modern society; and *Homo Ludens* (1938), a study of human culture as seen in play. Huizinga was jailed by Nazis during World War II and died on Feb. 1, 1945, shortly after his release. Mayke de Jong

Huizong, *hway dzawng* (reigned A.D. 1101-1126), also spelled *Hui-tsung*, the last emperor of the Northern Song dynasty of China, was the greatest imperial patron of art. A painter himself, he specialized in colorful, realistic bird and flower subjects. Huizong tried to keep court art at a high level of quality by supervising the training at the Imperial Academy. Huizong's art interests made him a careless and feeble ruler, and he was overthrown by the Tatars. Robert A. Rorex

Hull (pop. 252,200) has been one of England's leading industrial ports since it was founded by King Edward I in 1299. Hull, also called Kingston upon Hull, lies in northeastern England, at the point where the River Hull flows into the River Humber (see **England** [political map]).

Hull is an important manufacturing center. Its factories produce aircraft, beverages, chemicals, food products, and trailers. Hull's original port area extends about 7 miles (11 kilometers) along the Humber. It serves passenger and cargo ship lines between Hull and Europoort, a vast harbor in Rotterdam in the Netherlands. One of the world's longest single-span suspension bridges crosses the Humber near Hull. Hull also has two universities. German planes caused extensive damage to Hull during World War II (1939-1945). M. Trevor Wild

Hull, Bobby (1939-), was one of the greatest scorers in the history of professional hockey. He led the National Hockey League (NHL) in goals seven times and scored 50 or more goals five times. Hull scored 610 goals during 16 NHL seasons. He also led the NHL in points scored (goals plus assists) in the 1959-1960, 1961-1962, and 1965-1966 seasons. Hull, a left wing, was

AP/Wide World

Bobby Hull

nicknamed the "Golden Jet" because of his blond hair, skating speed, and powerful shots that sometimes traveled as fast as 110 miles (175 kilometers) per hour.

Hull played for the Chicago Blackhawks of the NHL from 1957-1958 through the 1971-1972 season. He won the Hart Memorial Trophy as the NHL's Most Valuable Player for the 1964-1965 and 1965-1966 seasons.

Hull played for the Winnipeg Jets of the World Hockey Association (WHA) for seven seasons, beginning with the 1972-1973 season. Hull returned to the NHL and played briefly for two teams during the 1979-1980 season before retiring. Robert Marvin Hull was born on Jan. 3, 1939, in Pointe Anne, Ontario. His son, Brett Hull, also became a leading NHL scorer. Larry Wigge

Hull, Clark Leonard (1884-1952), was an American psychologist known for his research on the learning process and for his mathematical approach to the study of behavior. Hull believed that human behavior could be studied as a science. His major work was a mathematical theory of learning. This theory emphasized the interrelationship of learning, which Hull called *habit,* and motivation, which he called *drive.* Hull was born May 24, 1884, near Akron, New York. He graduated from the University of Michigan and received a Ph.D. from the University of Wisconsin. In 1929, he joined Yale University's faculty. He died on May 10, 1952. Robert G. Weyant

Hull, Cordell (1871-1955), an American statesman, won the 1945 Nobel Peace Prize for his peace efforts while serving as United States secretary of state from 1933 to 1944. One of his greatest achievements was making the good-neighbor policy between the United States and Latin American countries effective. Hull believed in free trade and helped negotiate trade treaties that strengthened economic ties between nations of the Western Hemisphere. The treaties helped achieve political unity in the hemisphere during World War II (1939-1945). During the war, Hull led the drive to create the United Nations (UN). Before he resigned in 1944, he helped complete the first plans for the UN.

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Cordell Hull

Hull was born on Oct. 2, 1871, in Overton County (now Pickett County), Tennessee. He graduated from Cumberland Law School. He served in the Tennessee legislature, fought in the Spanish-American War in 1898, and was a circuit court judge in Tennessee. In 1907, Hull was elected to the U.S. House of Representatives. A follower of President Woodrow Wilson, Hull supported low tariffs as a basis for international economic cooperation.

Hull served as chairman of the Democratic National Committee in the 1920's. He was elected to the U.S. Senate in 1930. At the 1932 Democratic National Convention, he helped gain the presidential nomination for Franklin D. Roosevelt. Hull died on July 23, 1955. Alonzo L. Hamby

Hull, Isaac (1773-1843), commanded the United States warship *Constitution* when it defeated the British frigate *Guerrière* in the War of 1812. This battle proved his ability as a naval officer and made his ship famous as *Old Ironsides* (see Constitution). Born on March 9, 1773, in Derby, Connecticut, Hull commanded a ship before he was 21. He served in the U.S. Navy in conflicts with France (1798-1800) and the Barbary State of Tripoli in Africa (1801-1805). Hull died on Feb. 13, 1843. The Army officer William Hull was his uncle. Michael J. Crawford

Hull, William (1753-1825), was an American Army officer who served in the Revolutionary War and the War of 1812. During the Revolutionary War (1775-1783), Hull fought in battles at Princeton, Stony Point, and Trenton. During the War of 1812, he surrendered Detroit to the British, an action for which he was court-martialed.

In 1812, President James Madison ordered Hull to capture Upper Canada (the southern part of present-day Ontario), which was British territory. But the mission failed, and Hull's troops retreated to Detroit. The British army followed Hull, surrounded Detroit, and demanded surrender. Hull requested help from Fort Dearborn in the Illinois Territory, but Indians had captured or killed all the soldiers at the fort. Surrounded by the British and threatened by an Indian attack, Hull surrendered.

In 1814, a court-martial convicted Hull of cowardice and neglect of duty and sentenced him to death. But Madison canceled the sentence. Hull was born on June 24, 1753, in Derby, Connecticut, and died on Nov. 29, 1825. William Morgan Fowler, Jr.

See also **War of 1812** (Land campaign of 1812).

Hull House became the most famous settlement house in the United States. It was founded in Chicago in 1889 by two American social reformers, Jane Addams and Ellen Gates Starr. Hull House first occupied a dilapidated mansion that originally belonged to Charles J. Hull, a Chicago businessman. By 1907, the settlement included 12 new buildings and covered an entire block.

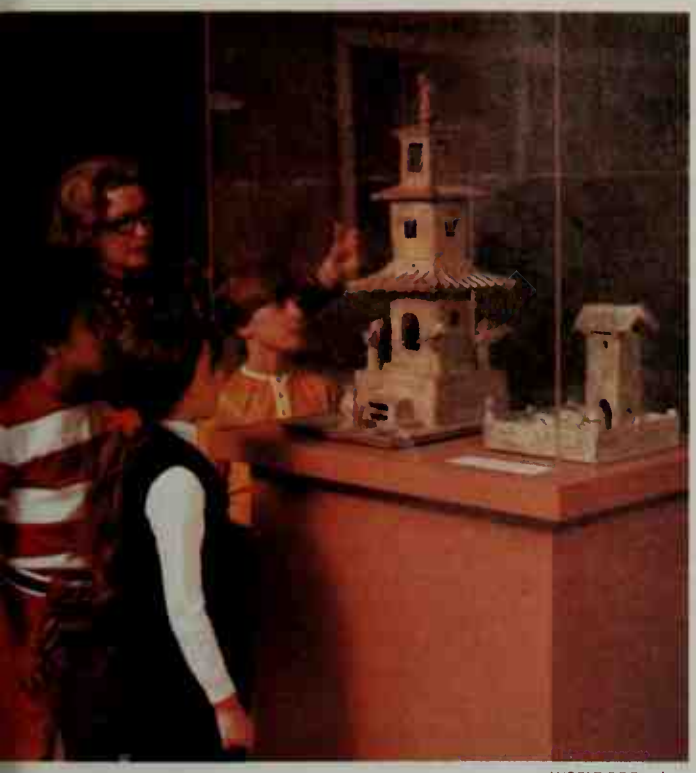
Many reform-minded people came to live in Hull House to help Chicago's poor. The residents organized the first public playground in Chicago in 1893 and the first juvenile court in the country in 1899. They also set up one of Chicago's first kindergartens, and promoted cleaner streets, better housing, and laws to regulate child labor. They also taught English, government, bookbinding, and other subjects to immigrants.

Addams served as head resident of Hull House until her death in 1935. She became one of the most famous women in the nation and a leader in many reform movements. Other Hull House residents who later became prominent included the social reformers Julia Lathrop and Florence Kelley and the physician Alice Hamilton.

In 1963, Hull House was torn down to make way for a campus of the University of Illinois. But the original Hull mansion and a dining hall were preserved and made into a museum. Today, the Hull House Association operates about 25 community centers in Chicago that provide child care, counseling, and housing. Allen F. Davis

See also **Addams, Jane; Kelley, Florence; Lathrop, Julia C.; Progressive movement** (picture); **Settlement house.**

Human being has the most highly developed brain of any animal. The human brain gives people many special abilities, the most outstanding of which is the ability to speak. Language has enabled human beings to develop *culture,* which consists of ways of behaving and thinking. These ways are passed on from generation to generation through learning. Culture also includes *technol-*



WORLD BOOK photo

Human beings, unlike any other creatures, use art and language to preserve a knowledge of history. The museum guide above is describing ancient Chinese buildings and ways of life.

ogy—that is, the tools and techniques invented by people to help satisfy their needs and desires. The richness and complexity of human culture distinguish human beings from all other animals.

The human brain helps make people the most adaptable of all creatures. They behave with the most flexibility and in the greatest variety of ways. The human body is highly adaptable because it has few specialized features that could limit its activities. In contrast, a seal has a body streamlined for swimming, but it has difficulty moving about on land. People cannot swim as well as a seal, but they can also walk, run, and climb. Human adaptability enables people to live in an extremely wide variety of environments—from the tropics to the Arctic.

People are inquisitive and have long sought to understand themselves and their place in the world. Throughout much of human existence, religion has helped provide such understanding. All societies have assumed one or more gods influence their lives and are responsible for their existence. Since ancient times, *philosophy* (the study of truth and knowledge) has also provided definitions of what it means to be human.

Today, religion and philosophy remain important parts of people's efforts to understand the nature of human existence. But many other fields of study also help human beings learn about themselves. For example, *anthropology* is the study of human cultures and of human physical and cultural development. *Linguistics* is the scientific study of language. Specialists in *psychology* study human and animal behavior and mental processes. *Sociology* deals with the groups and institutions that make up human societies, and *history* is the study of past human events. Each of these fields has a separate article in *World Book*.

This article describes the physical and cultural characteristics that distinguish human beings from other animals. It also traces human physical and cultural development. For more information on the life of early human beings, see Prehistoric people.

Characteristics of human beings

Scientific classification. Biologists classify all living things in groups, including *class, order, family, genus,* and *species.* Human beings belong to the class of animals called *mammals.* There are about 4,500 species of mammals, including such animals as cats, dogs, elephants, and otters. All mammals have a backbone, hair, four limbs, and a constant body temperature. Female mammals are the only animals with special glands that produce milk for feeding their young.

Human beings, along with apes, monkeys, lemurs, and tarsiers, make up the order of mammals called *primates.* Scientists classify human beings and apes in the superfamily *Hominoidea.* The family *Hominidae* consists of human beings and their closest prehuman ancestors. Human beings are the only living members of a genus called *Homo,* the Latin word for *human being.* This genus consists of one living species—*Homo sapiens*—and several extinct human species that are known only through fossil remains. The Latin words *Homo sapiens* mean *wise human being.* All existing peoples belong to the subspecies *Homo sapiens sapiens.*

Physical characteristics. Human beings and the other primates share many physical features. For example, both human beings and apes rely on their excellent vision for much of their information about the environment. They have large eyes, sensitive retinas, and *stereoscopic vision* (the ability to perceive depth). Human beings and apes also have a highly developed nervous system and a large brain. Human beings and many other primates have long, flexible fingers and *opposable thumbs,* which can be placed opposite the fingers for grasping. In addition, their fingers and toes have nails instead of claws.

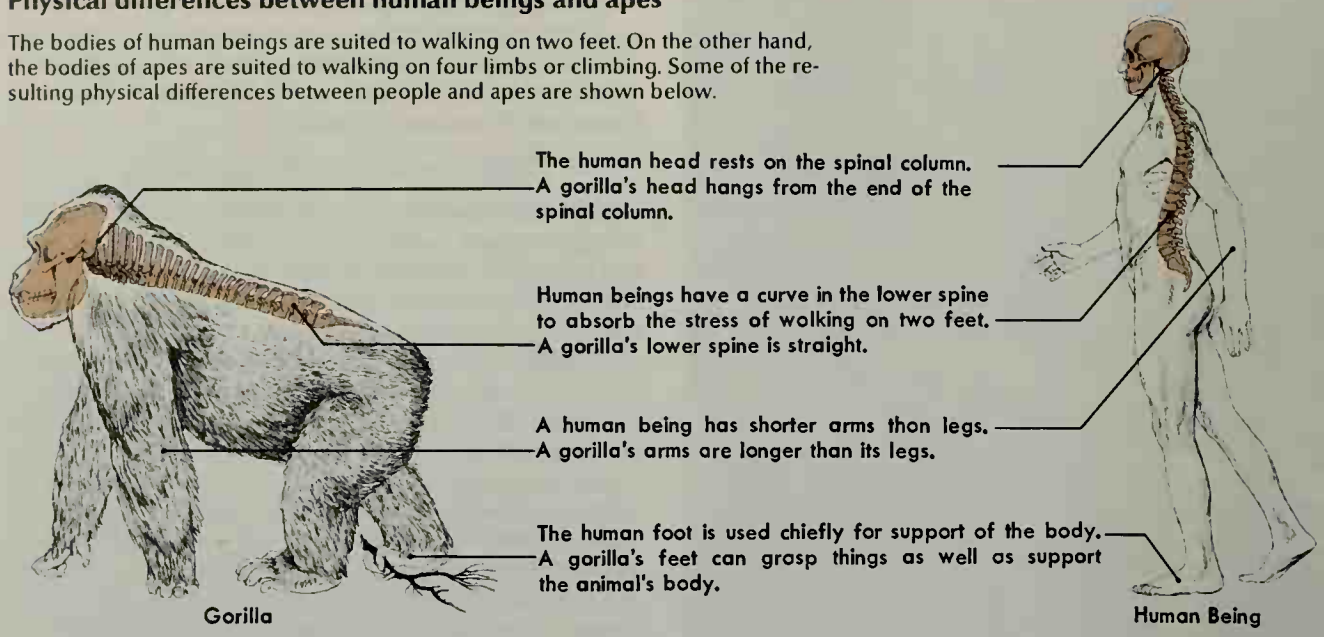
Many of the physical characteristics that distinguish human beings from other primates are related to the ability of people to stand upright and walk on two legs. This ability chiefly requires long, powerful legs. The human rump has strong muscles that propel the body forward and balance the trunk alternately on each leg when a person walks. In contrast, apes spend most of their time climbing and swinging in trees or walking on all four limbs. Their rumps have relatively weak muscles, and their arms are longer and stronger than their legs.

The human spine, unlike the spine of any other animal, has a curve in the lower back. This curve helps make upright posture possible by placing the body's center of gravity directly over the pelvis. The human foot is also specially adapted for walking on two legs. Apes use all four limbs to support their weight, and they can grasp objects almost as well with their feet as with their hands. In human beings, however, the feet support the entire weight of the body, and the toes have little ability to grasp or to move independently.

The human brain is extremely well developed and at least twice as large as any ape's brain. Because of the brain's size, the human skull is rounder than any other primate's skull.

Physical differences between human beings and apes

The bodies of human beings are suited to walking on two feet. On the other hand, the bodies of apes are suited to walking on four limbs or climbing. Some of the resulting physical differences between people and apes are shown below.



WORLD BOOK illustration by Anthony Saris

Human beings live longer and develop more slowly than other primates. The human life span varies from an average of about 40 years in many developing countries to more than 70 years in most industrial nations. A human infant is born completely helpless and depends on its parents for many years. Most human beings reach full maturity only between 18 and 25 years of age. Slow growth and development allow for a much longer period of learning and brain growth than exists in any other species.

Cultural characteristics. Some animals have simple aspects of culture. For example, young chimpanzees learn from older members of their group how to make some tools. They catch termites by peeling a twig and inserting it into a termite mound. They also chew leaves to make sponges for soaking up water to drink.

Certain animals, including apes and monkeys, communicate by making a wide variety of sounds. These sounds express emotion and may communicate simple messages, but they apparently do not symbolize any object or idea. Language distinguishes human culture from all forms of animal culture. Through elaborate use of symbols, language enables people to express complex ideas and to communicate about objects and events that are distant in time and place. By using language, human beings have developed the ability to reason and to solve problems on a far higher level than any other animal. Language also enables human beings to pass on knowledge and skills from generation to generation.

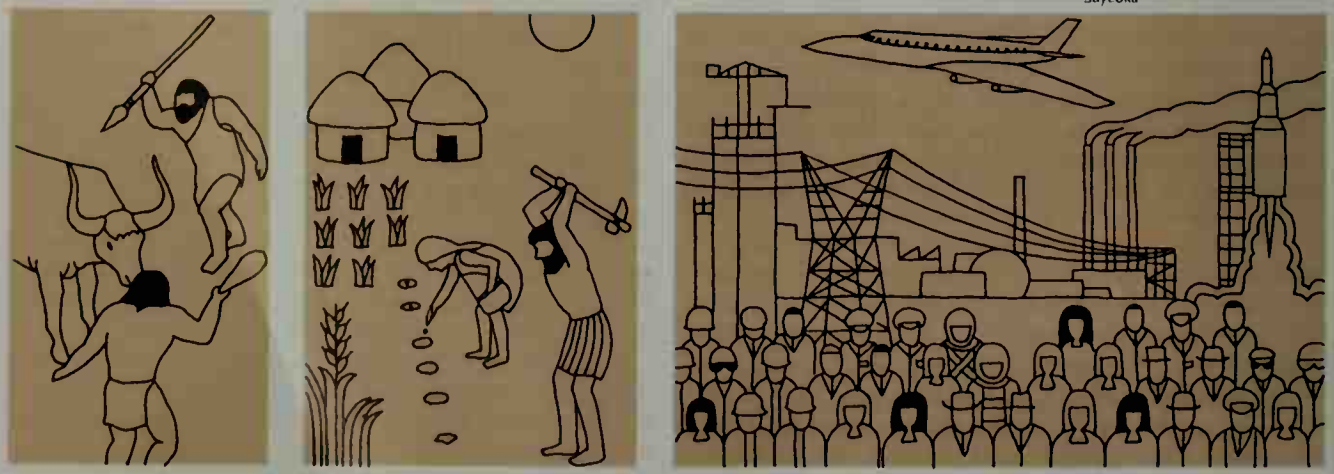
Human physical development

The Bible describes how God created the world and all its living things, including the first human beings, in six days. Many people accept this description as fact.

Human cultural development

Human cultural development can be divided into three phases. The earliest societies, *left,* hunted wild animals and gathered wild plants for food. Agricultural societies, *center,* controlled their food sources by farming. Industrial societies, *right,* use advanced technology, resulting in both major achievements and complex problems.

WORLD BOOK illustration by George Suyeoka



Evidence from fossils has convinced most scientists that human beings developed over millions of years from ancestors that were not completely human. However, the fossil record does not yet provide enough information to trace human development in detail. As a result, not all experts agree on how human beings developed. This section describes human physical development as a majority of anthropologists believe it occurred.

Prehuman ancestors. Anthropologists believe human beings, chimpanzees, and gorillas all developed from a common ancestor that lived from 5 million to 10 million years ago. Many scientists once thought that the earliest direct ancestor of human beings was a creature called *Ramapithecus.* This creature lived from 8 million to 14 million years ago. During the late 1900's, however, discoveries of *Ramapithecus* fossils suggested the creature was an ancestor of the orangutan, a kind of ape.

More than 4 million years ago, a more advanced form of humanlike creature called *Australopithecus* appeared in Africa. Fossil remains of the australopithecine skeleton indicate that these creatures stood fully erect and walked on two legs. The australopithecines were about 4 to 5 feet (120 to 150 centimeters) tall and had a brain about a third the size of a modern human brain.

Early human beings. Many scientists regard the species *Homo habilis* (skillful human being) as the first type of human being. These primitive people appeared about 2 million years ago in Africa and are believed to have developed from the australopithecines. Archaeological evidence shows that *Homo habilis* used stone tools. *Homo habilis* fossils have been found at Lake Turkana in Kenya and at other sites in eastern Africa. Some scientists believe that another species of human being, called *Homo rudolfensis,* lived at the same time as *Homo habilis.*

Most scientists believe that *Homo habilis* developed into a more advanced type of prehistoric human being known as *Homo erectus* (erect human being). *Homo erectus* appeared about 1,800,000 years ago in Africa and spread to Asia and Europe. It had a larger brain and a more humanlike skull than its ancestors. From the neck down, *Homo erectus* resembled the human beings of today. But it had a low forehead and a large jaw like *Homo habilis* and the australopithecines. The culture of *Homo erectus* was more highly developed than that of *Homo habilis. Homo erectus* made and used a wider variety of stone tools than its ancestors did. It learned how to make fire about 600,000 years ago and was probably the first human species to do so. Fossils indicate that *Homo erectus* may have hunted large animals, and this sort of hunting would have required planning and cooperation.

Human beings of today. Most scientists believe that *Homo erectus* developed into the species *Homo sapiens* between about 400,000 and 300,000 years ago. *Homo sapiens* basically resembled *Homo erectus* but had a larger brain and smaller jaws and teeth. As time passed, *Homo sapiens* developed a rounded skull and long, straight limbs. *Homo sapiens* looked like today's human beings by at least 40,000 years ago and perhaps as early as 100,000 years ago. A majority of anthropologists classify all people who have lived in the last 40,000 years as *Homo sapiens.*

Human cultural development

Human culture has developed in three major phases. These phases have been based on (1) hunting and gathering societies, (2) agricultural societies, and (3) industrial societies.

Hunting and gathering societies. For almost the entire prehistoric period of human existence, people lived by hunting game and gathering fruit, nuts, roots, seeds, and other plant foods. Archaeological evidence suggests that the hunters and gatherers lived in widely separated groups of 25 to 50 persons. These primitive people wandered over large areas in search of food. They lived in harmony with their environment and used their natural resources efficiently.

The first inventions probably included weapons and cutting tools for butchering animals, plus containers for gathering plant foods. As people improved their hunting skills, they obtained large amounts of meat by killing huge mammals, including elephants.

Agricultural societies became possible after people began to domesticate wild animals and plants about 9000 B.C. These farming activities greatly increased the amount of food available in any area. Permanent villages started to appear, and then towns and cities developed. The larger and more dependable supply of food supported a continually increasing population.

Agriculture made it unnecessary for everyone to help in the production of food. Some people became specialists in other fields, such as manufacturing or trade. Governments were established and systems of writing were created. Thus, the invention of farming opened the way for the development of civilization.

Industrial societies appeared in their modern form during the A.D. 1700's, after people learned to run machinery with energy from coal and other fuels. Today, petroleum, coal, natural gas, and nuclear fuel furnish most of the energy used by industrial societies. These fuels have brought a great expansion of technology.

The processes and products developed by industry have greatly improved the standard of living for countless people. These developments have also helped make possible many other advances, including tremendous increases in human knowledge. But not all nations and economic classes have received the full benefits of industrial progress. Industrial technology also has produced many negative side effects. Its wastes have polluted the environment, and its production methods have sometimes created monotonous, unfulfilling jobs.

Bernard G. Campbell

Related articles. See Prehistoric people and its list of *Related articles.* See also the following articles:

Ape
Civilization
Culture
Human body
Primate
Races, Human

Additional resources

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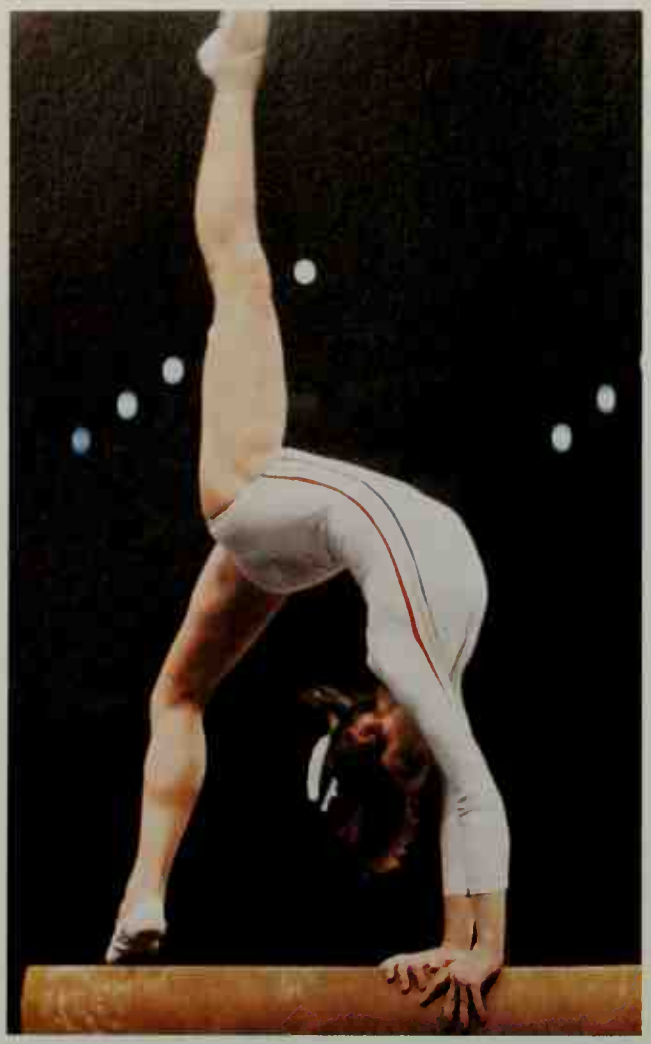
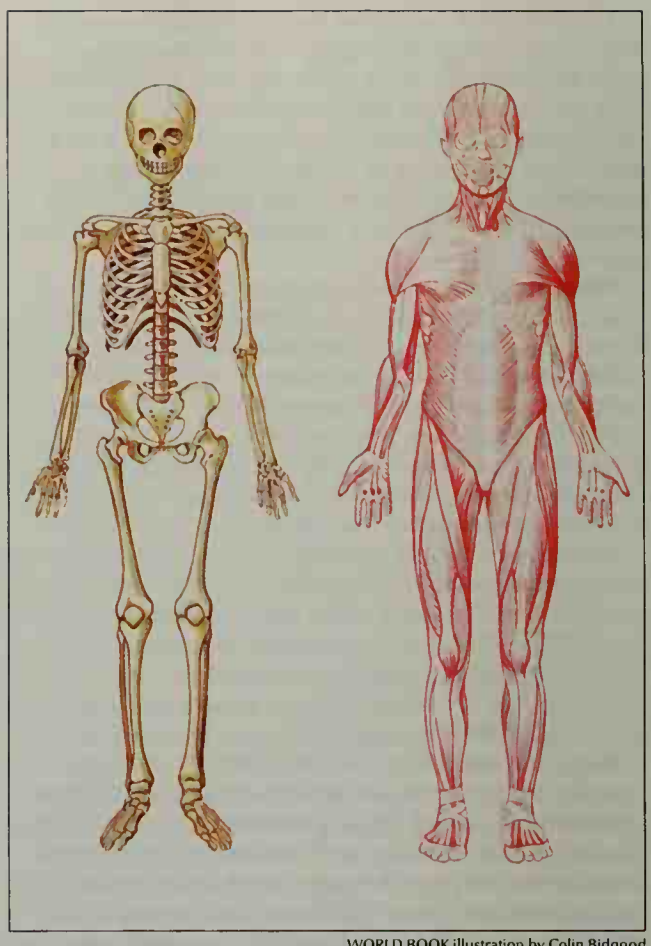


Tony Duffy, Focus on Sports

The human body can perform amazing acts of strength and grace. A highly trained athlete can push the body to the limits of its powers.



WORLD BOOK illustration by Colin Bidgood

The skeletal system includes more than 200 bones and makes up about 18 percent of the body's weight. It provides the body with a sturdy framework. Bone is strong, yet light and flexible.

The muscular system consists of nearly 700 muscles and makes up about 40 percent of the body's weight. Muscles can *contract* (shorten). By contracting, the muscles enable the body to move.

Human body

Human body. People sometimes call the human body a machine—the most wonderful one ever built. Of course, the human body is not a machine. But it can be compared to one in many ways. Like a machine, the body is made up of many parts. Each part of the body, like each part of a machine, does special jobs. But all the parts work together and so make the body or the machine run smoothly. Also like a machine, the body needs energy to work. In such a machine as an automobile, the energy comes from gasoline. In the body, it comes from food or oxygen.

Although the human body can be compared to a machine, it is far more amazing than any machine. It can do things that no machine can do. For example, the body can grow. The body starts out as one cell. In time, this tiny cell develops into a body consisting of trillions of cells. The human body can also replace certain worn-out parts. Each day, several billion cells in the body die and are replaced by cell division. Thus, the body is always rebuilding itself. Every 35 to 45 days, for instance, the human body replaces the outermost layer of skin.

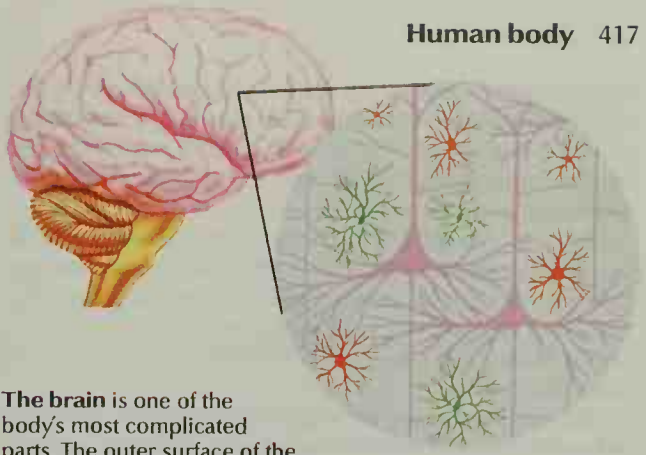
The human body can defend itself against hundreds of diseases. The body can also repair itself after most small injuries. Many body parts, such as the heart and kidneys, work continuously. The heart of a 70-year-old person, for example, has pumped about 55 million gallons (208 million liters) of blood during that person's life. The person's kidneys have also removed wastes from more than 1 million gallons (3.8 million liters) of blood.

By using its senses, the body can detect changes in its surroundings, such as changes in temperature, light, or sounds. It can adjust to these changes quickly. The body's senses are truly incredible. For instance, people can learn to identify thousands of odors, yet smell is one of the least developed senses in human beings. The human body can also detect changes that occur within itself, such as changes in body temperature. The various parts of the body continuously adjust their activities to keep the "inside" environment normal. Such adjustments rely on a system of nerves that carries messages from

John R. Conway III, the contributor of this article, is Associate Professor of Biology at the University of Scranton in Pennsylvania.

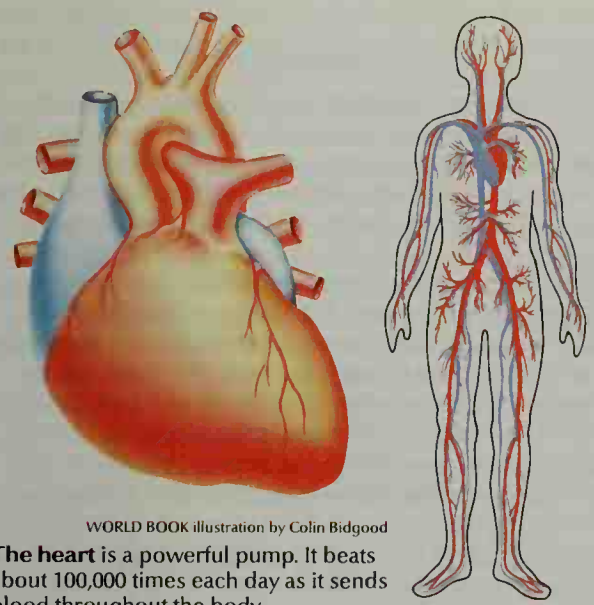
Lennart Nilsson from *Behold Man* © 1974 Little, Brown and Company

The human eye, like many parts of the body, rapidly adjusts to changes. In a darkened room, the pupil of the eye opens wide and so lets in more light, *left.* If the room lights are turned up, the pupil automatically shrinks within seconds, *right.*



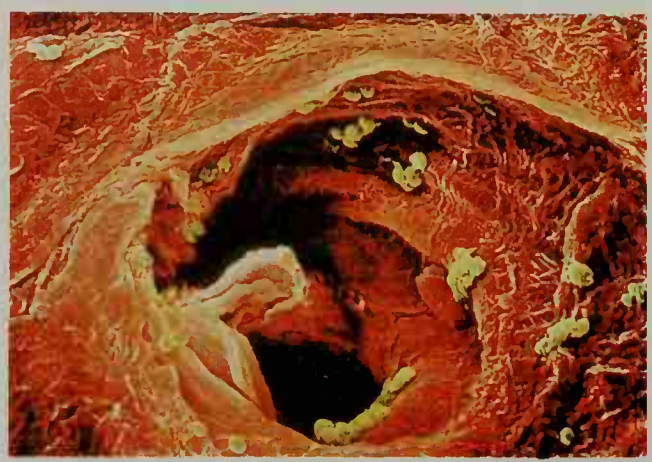
WORLD BOOK illustration by Colin Bidgood

The brain is one of the body's most complicated parts. The outer surface of the brain is made up of around 20 billion cells. A few of these cells are shown in the circle.



WORLD BOOK illustration by Colin Bidgood

The heart is a powerful pump. It beats about 100,000 times each day as it sends blood throughout the body.



Lennart Nilsson from *Behold Man* © 1974 Little, Brown and Company

A microscopic view of the skin shows bacteria as tiny green balls. Countless bacteria live on the skin. These bacteria are harmless unless they enter the body through a break in the skin.

one part of the body to another. The messages travel at speeds of up to 400 to 425 feet (120 to130 meters) per second.

The most remarkable part of the human body is the brain. The human brain is so highly developed that it makes people different from all other living things. Their magnificent brain makes people able to think. They can compose silly rhymes or beautiful poetry. They can imagine a dream world or study the mysteries of the atom. No animal—no matter how smart—and no computer—no matter how powerful—can think like a human being.

What the body is made of

The human body has many parts. This section of the article describes the organization of the body, from its smallest parts through its largest ones.

Chemical elements and molecules. Like all things—living and nonliving—the human body consists of atoms of chemical elements. The most common chemical elements in the body are carbon, hydrogen, nitrogen, and oxygen. The body also contains smaller amounts of many other elements, including calcium, iron, phosphorus, potassium, and sodium.

Atoms of chemical elements combine and form microscopic compounds called *molecules.* The most common molecule in the human body is water. A molecule of water consists of two atoms of hydrogen and one atom of oxygen. Water usually makes up 55 to 65 percent of the body. Most of the chemical reactions that occur in the body require water.

Except for water, all of the chief molecules in the body contain the element carbon. The most important carbon-containing molecules are large, complicated compounds called *macromolecules.* There are four main kinds of macromolecules in the body: *carbohydrates, lipids, proteins,* and *nucleic acids.* Carbohydrates provide energy that powers all the body's activities. Lipids have several jobs. Some lipids, particularly the fats, store extra fuel. Other lipids serve as one of the building materials for the cells that make up the body. Proteins also have various duties. Many proteins serve as building blocks for cells. Other proteins, called *enzymes,* speed up the chemical reactions within the body. Nucleic acids carry instructions that tell each cell how to perform its particular jobs. For more information on macromolecules, see the article **Life** (The chemical basis of life).

Cells and tissues. The cell is the basic unit of all living things. The cells of the human body consist chiefly of molecules of water, proteins, nucleic acids, and lipids. The molecules that make up the cells are not alive, but the cells themselves are living things. Each of

the body's cells is able to take in food, get rid of wastes, and grow. Most of the cells can also reproduce. A thin covering consisting of proteins and lipid molecules encloses each cell. This covering permits only certain substances to enter or leave the cell.

Nearly all the cells in the body are too tiny to see without a microscope. Yet packed within each cell is the machinery that the cell needs to carry out its many activities. For a detailed discussion of a cell's machinery and how it works, see the article **Cell** (Inside a living cell; The work of a cell).

The body has many basic kinds of cells, such as blood cells, muscle cells, and nerve cells. Each kind of cell has special features and jobs.

Cells of the same type form tissues. The body has four chief kinds of tissues. (1) *Connective tissue* helps support and join together various parts of the body. Most connective tissue is strong and elastic. (2) *Epithelial tissue* covers the body surface and so forms the skin. It also lines the mouth, the throat, and other passages and cavities inside the body. Epithelial tissue prevents harmful substances from entering the body. (3) *Muscle tissue* consists of threadlike fibers that can *contract* (shorten). Muscle tissue makes it possible for the body to move. (4) *Nervous tissue* carries signals. It permits various parts of the body to communicate with one another.

Organs and organ systems. An organ consists of two or more kinds of tissues joined into one structure that has a certain task. The heart, for example, is an organ whose job is to pump blood throughout the body. Connective tissue, epithelial tissue, muscle tissue, and nervous tissue make up the heart.

Groups of organs form organ systems. Each organ system carries out a major activity in the body. For example, the digestive system consists of various organs that enable the body to use food. Similarly, the nervous system is made up of organs that carry messages from one part of the body to another and processes them. The remainder of this article discusses the main organ systems of the human body. For more detailed descriptions of the major organs and organ systems, see the articles listed in the *Related articles* at the end of this article.

The skin

The skin is the largest organ of the body. The skin, including nails, hair, and sweat glands, is sometimes called the *integumentary system.* If the skin of a 150-pound (68-kilogram) person were spread out flat, it would cover approximately 20 square feet (1.9 square meters). Skin has two layers: the epidermis and the dermis. Subcutaneous tissues provide protection for the skin.

The epidermis forms the outermost layer of the skin. It serves as a barrier between the outside world and the inner tissues of the body. The outer portion of the epidermis consists of tough, dead cells that prevent bacteria, chemicals, and other harmful substances from entering the body. It also protects the body's inner tissues from the harsh rays of the sun and prevents the loss of water from these tissues.

The dermis is the lower layer of the skin. The dermis helps keep the temperature of the body within its normal range. The body produces tremendous amounts of heat as it uses food. Some of this heat escapes from the body through the blood vessels in the dermis. When the body needs to retain heat, these blood vessels narrow and so limit heat loss. When the body needs to give off heat, the blood vessels in the dermis expand and so increase heat loss. The sweat glands, which come from the epidermis, also help control body temperature. These glands produce sweat, which is released through pores on the skin surface. As the sweat evaporates from the surface, it cools the body.

The dermis also serves as an important sense organ. Nerve endings within the dermis respond to cold, heat, pain, pressure, and touch.

Subcutaneous tissues lie directly beneath the skin. They provide extra fuel for the body. The fuel is stored in fat cells. Subcutaneous tissues also help retain body heat and cushion the inner tissues against blows to the body.

The skeletal system

The skeleton of an adult consists of more than 200 bones. The skeleton forms a strong framework that supports the body. It also helps protect the internal organs. For example, the brain is shielded by the skull, the spinal cord by the spinal column, and the heart and lungs by the ribs.

The skeleton works together with the muscles in enabling the body to move. The bones of the shoulders and arms, for instance, serve as levers against which the muscles that move the arm can pull. The place where bones meet is called a joint. There are two basic kinds of joints. (1) *Movable joints,* such as the elbow, knee, and shoulder joints, permit varying degrees of motion. The bones of a movable joint are held together by bundles of tough, flexible connective tissue called *ligaments.* (2) *Immovable joints* do not permit any movement of the bones. The bones of the skull, except for the jawbones, meet in immovable joints.

The skeleton serves as more than a framework for the body and a system of levers to help move the body. Bone tissue contains various kinds of cells that play a major role in keeping the blood healthy. The cells of red bone *marrow*—the soft, fatty core of many bones—produce new blood cells and release them into the bloodstream. Yellow bone marrow, the most common type of marrow in the adult skeleton, stores fat. Yellow bone marrow does not normally produce blood cells.

Two kinds of bone cells regulate the mineral content of the blood. One kind removes calcium, phosphorus, and other minerals from the blood and deposits them in the bone. The other kind dissolves old mineral deposits and releases the minerals back into the bloodstream as needed.

The muscular system

The muscular system moves the body. The body has almost 700 muscles, each of which consists of special fibers that can contract. When a muscle contracts, it pulls the tissue to which it is attached. This pulling results in movement.

The muscles of the human body can be divided into two main types: (1) skeletal muscles and (2) smooth muscles. A third kind of muscle, *cardiac muscle,* is found only in the heart. It has features of both skeletal muscle and smooth muscle.

Skeletal muscles are attached to the bones. They move the bones of the arms, legs, fingers, and other parts of the skeleton. We can consciously control the skeletal muscles, and so they are known as *voluntary muscles*. The fibers that make up a skeletal muscle have alternate light and dark crossbands called *striations*.

One end of each skeletal muscle is attached to a bone that does not move when the muscle contracts. In most cases, the other end of the muscle is attached to another bone, either directly or by means of cordlike bundles of connective tissue called *tendons*. This second bone moves when the muscle contracts.

Muscles move the body only by pulling. They cannot push the tissues to which they are attached. Two sets of muscles therefore control most skeletal movements, such as the raising and then lowering of the forearm. One set pulls the bones in one direction, and the other set pulls the bones in the opposite direction. For example, one set of muscles pulls the forearm up, but it cannot push the forearm down. To lower the forearm, a second set of muscles must contract and pull it down.

Smooth muscles are found in most of the body's internal organs. Unlike skeletal muscles, smooth muscles do not have striations. Smooth muscles in the walls of the stomach and intestines move food through the digestive system. Smooth muscles also control the diameter of the blood vessels and the size of the breathing passages. In all these cases, the smooth muscles contract and relax automatically—that is, we do not consciously control them. For this reason, they are often called *involuntary muscles*.

Smooth muscles cannot contract as rapidly as skeletal muscles. But smooth muscles can contract more completely than skeletal muscles and do not tire as quickly. Smooth muscles can thus produce powerful, rhythmic contractions over long periods.

Cardiac muscle has striations like skeletal muscle. But like smooth muscle, it contracts automatically and rhythmically without tiring. Cardiac muscle enables the heart to beat an average of 70 times a minute without rest throughout a person's lifetime.

The digestive system

The digestive system breaks down food into simple substances that the cells can use. It then absorbs these substances into the bloodstream and eliminates any leftover waste matter.

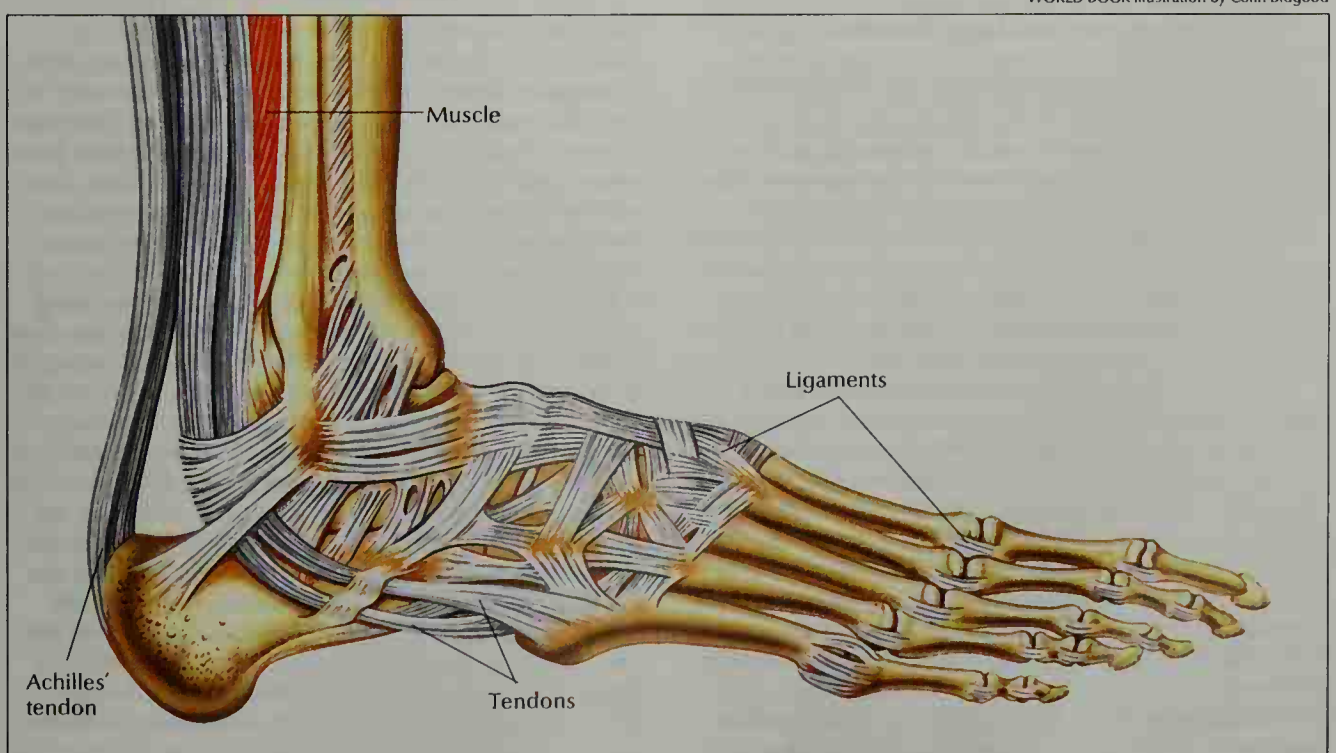
The main part of the digestive system is a long tube called the *alimentary canal*. This tube consists of (1) the mouth, esophagus, and stomach; and (2) the small intestine and large intestine. Other parts of the digestive system include the gallbladder, liver, pancreas, salivary glands, and teeth.

The mouth, esophagus, and stomach. Digestion begins in the mouth, where the teeth tear and grind food into small pieces. Small pieces of food are more easily broken down during the digestive process than large ones. Therefore, thorough chewing is important. As food is chewed, three pairs of large salivary glands pour saliva into the mouth. Saliva moistens the food, making it easier to swallow. Saliva also contains the first of the system's several digestive enzymes. The digestive enzymes break food down into smaller molecules the body can use.

After the food is swallowed, it enters the esophagus. The esophagus is a long, muscular tube that leads to the

Ligaments and tendons Ligaments and tendons consist of tough, elastic connective tissue. Ligaments connect one bone to another. They hold the bones in place but still allow some movement. Tendons connect a muscle to a bone. When the muscle contracts, the strong, cablelike tendon pulls the bone to which it is attached. The large Achilles tendon links the calf muscle to the heel bone.

WORLD BOOK illustration by Colin Bidgood



Lennart Nilsson from *Behold Man* © 1974 Little, Brown and Company

A magnified cross section of the small intestine shows the tiny, fingerlike structures that line this organ. These structures, called villi, increase the surface area of the small intestine. They enable the organ to absorb large amounts of useful substances from digested food.

stomach. Contractions of smooth muscles move the food down the esophagus and into the stomach. The stomach is the widest part of the alimentary canal. It serves as a sort of "holding tank" in which food remains for several hours. During this time, the stomach produces an acid and an enzyme that further break down much of the food. Muscle contractions mix the partly digested food into a mass called *chyme.*

The small intestine and large intestine. Chyme passes from the stomach into the small intestine at a steady rate. Various digestive enzymes complete the breakdown of the food within the first section of the small intestine. The small intestine produces some of these enzymes. The rest are made by the pancreas. The pancreatic enzymes empty into the small intestine through a *duct* (tube). *Bile,* a liquid made by the liver and stored in the gallbladder, also enters the small intestine through the same duct in most people. Bile does not contain digestive enzymes, but it aids digestion by breaking up large molecules of fatty foods.

By the time the food leaves the first section of the small intestine, it has been mainly digested. Special cells line the walls of the remainder of the small intestine. These cells absorb useful substances from the digested food. The absorbed substances enter the blood and the lymph. Some of the substances are carried directly to cells throughout the body. The rest are transported to the liver. The liver stores some of the substances, releasing them as the body requires. It chemically alters the other substances, changing them into forms needed by the body.

The substances not absorbed by the small intestine pass to the large intestine. These substances consist of water, chemicals, vitamins, and wastes. The large intestine absorbs most of the water and chemicals, including sodium and chloride, and some vitamins, which then enter the bloodstream. The wastes move toward the *anal canal,* the end of the large intestine, and leave the body as bowel movements.

The respiratory system

The respiratory system consists of the organs of breathing. These organs include the nose, the *trachea* (windpipe), *larynx* (the voice box), *pharynx* (the cavity behind the nose and mouth), and a pair of lungs. The respiratory system has two main jobs. (1) It provides the body with oxygen. (2) It rids the body of carbon dioxide. The cells of the body need oxygen to break down and release the energy in food. During this process, carbon dioxide forms as a waste product.

Breathing involves the acts of inhaling and exhaling. Inhaling occurs as the chest cavity expands. As the chest expands, so do the lungs. Air from the atmosphere rushes in and fills the enlarged lungs. Exhaling occurs as the chest cavity shrinks, which pushes air out of the lungs. Inhaling and exhaling result chiefly from contractions of the *diaphragm,* a large muscle that forms the floor of the chest cavity. As the diaphragm contracts, the cavity expands. As it relaxes, the cavity shrinks. The muscles that move the ribs also play a part in the breathing process.

The air passages. When we inhale, air enters the body through the nose. Air may also enter through the mouth. The air flows from the nostrils to the nasal passages. The nasal passages are lined with tiny hairlike structures called *cilia* and a sticky substance called *mucus.* The cilia and the mucus filter dust and dirt from the

air. In addition, cold air is warmed and moistened as it moves through the nasal passages. From the nose and mouth, the air passes through the *pharynx* and the *larynx*. The air then enters the trachea.

The trachea carries the air toward the lungs. Before reaching the lungs, the trachea splits into two tubes called the *primary bronchi*. Each tube enters one lung. Within the lungs, the primary bronchi divide into smaller and smaller tubes, finally branching into extremely tiny tubes called *bronchioles*. The bronchioles end in hundreds of millions of thin-walled structures called *alveoli* or *air sacs*. The alveoli give the lungs tremendous surface area. If the air sacs were flattened out, the lungs would cover from 600 to 1,000 square feet (56 to 93 square meters).

The exchange of carbon dioxide and oxygen occurs in the alveoli. Each alveolus is surrounded by a network of small blood vessels. Like the alveoli, these vessels have extremely thin walls. Blood that enters the vessels has a high level of carbon dioxide, which it picked up from the body tissues. The carbon dioxide leaves the blood and moves through the walls of the blood vessels and alveoli into the lungs. Oxygen from the air inside the lungs then passes through the walls of the alveoli and blood vessels and into the blood. The oxygen-rich blood leaves the lungs and travels to the heart, which pumps it to cells throughout the body. The carbon dioxide is expelled from the lungs when we exhale.

The circulatory system

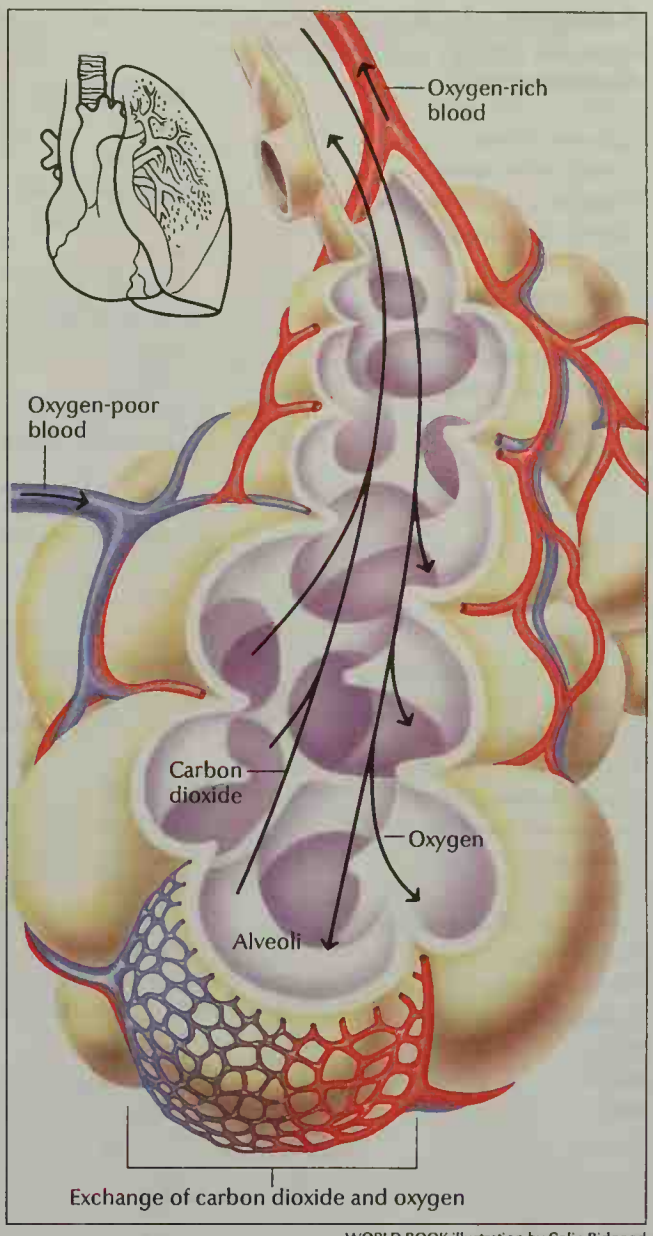
The circulatory system moves blood throughout the body. Blood transports food and oxygen to the cells and carries away carbon dioxide and other wastes. The cells cannot live without a continuous supply of fresh blood. The circulatory system also carries disease-fighting substances called *antibodies*. In addition, it transports chemical messengers called *hormones*. Hormones are discussed in the section of this article called *The endocrine system*.

The circulatory system consists chiefly of (1) the heart, (2) the blood vessels, and (3) the blood.

The heart is a hollow muscle that pumps blood through the circulatory system by contracting and relaxing rhythmically. The heart actually consists of two pumps that lie side by side. The left side of the heart makes up the stronger pump. It receives oxygen-rich blood from the lungs and sends it to cells throughout the body. The blood, which picks up carbon dioxide and other wastes from the cells, returns to the right side of the heart. This weaker pump moves the blood to the lungs and then back to the left side of the heart. In the lungs, the carbon dioxide is removed from the blood, and oxygen is added.

The blood vessels form a branching network of about 60,000 miles (100,000 kilometers). They can be divided into three types (1) *Arteries* carry blood from the heart. (2) *Veins* carry blood to the heart. (3) *Capillaries* connect the arteries and veins.

Blood leaves the left side of the heart through the *aorta*. This vessel is the largest artery in the body. Several major arteries branch off the aorta. These arteries, in turn, divide into smaller and smaller vessels. Finally, the smallest arteries empty into the tiny capillaries. Through



WORLD BOOK illustration by Colin Bidgood

Carbon dioxide and oxygen are exchanged in the lungs, which lie close to the heart. One lung is shown with the heart at the upper left. Each lung contains millions of *alveoli*, or *air sacs*. Blood vessels, shown here only on the bottom sac, surround each alveolus. As blood flows through these vessels, it releases carbon dioxide, a waste picked up from the body tissues, into the alveoli. It then receives fresh oxygen from the alveoli.

the thin walls of the capillaries, food and oxygen in the blood are exchanged for carbon dioxide and other wastes from individual cells.

From the capillaries, the blood enters small veins, which join larger and larger veins. Finally, it enters the right side of the heart through the *superior vena cava* and *inferior vena cava*, the body's two largest veins. The right side of the heart then pumps the blood through the *pulmonary arteries* to the capillaries surrounding air sacs in the lungs. The oxygen-rich blood returns from the lungs to the left side of the heart through four *pulmonary veins*. The left side of the heart then pumps the blood out through the aorta, and the blood's journey begins again.

The blood consists of a liquid and three kinds of cells

Anatomy of the human body

Each page in this series shows one or more of the human body's major systems. The index below keys the numbers found in the illustrations to an alphabetical list of each system's parts.

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Carpals (wrist bones) 3
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Collarbone (clavicle) 5
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*The spleen lies in front of and just above the left kidney (104). See the drawing with the Spleen article.

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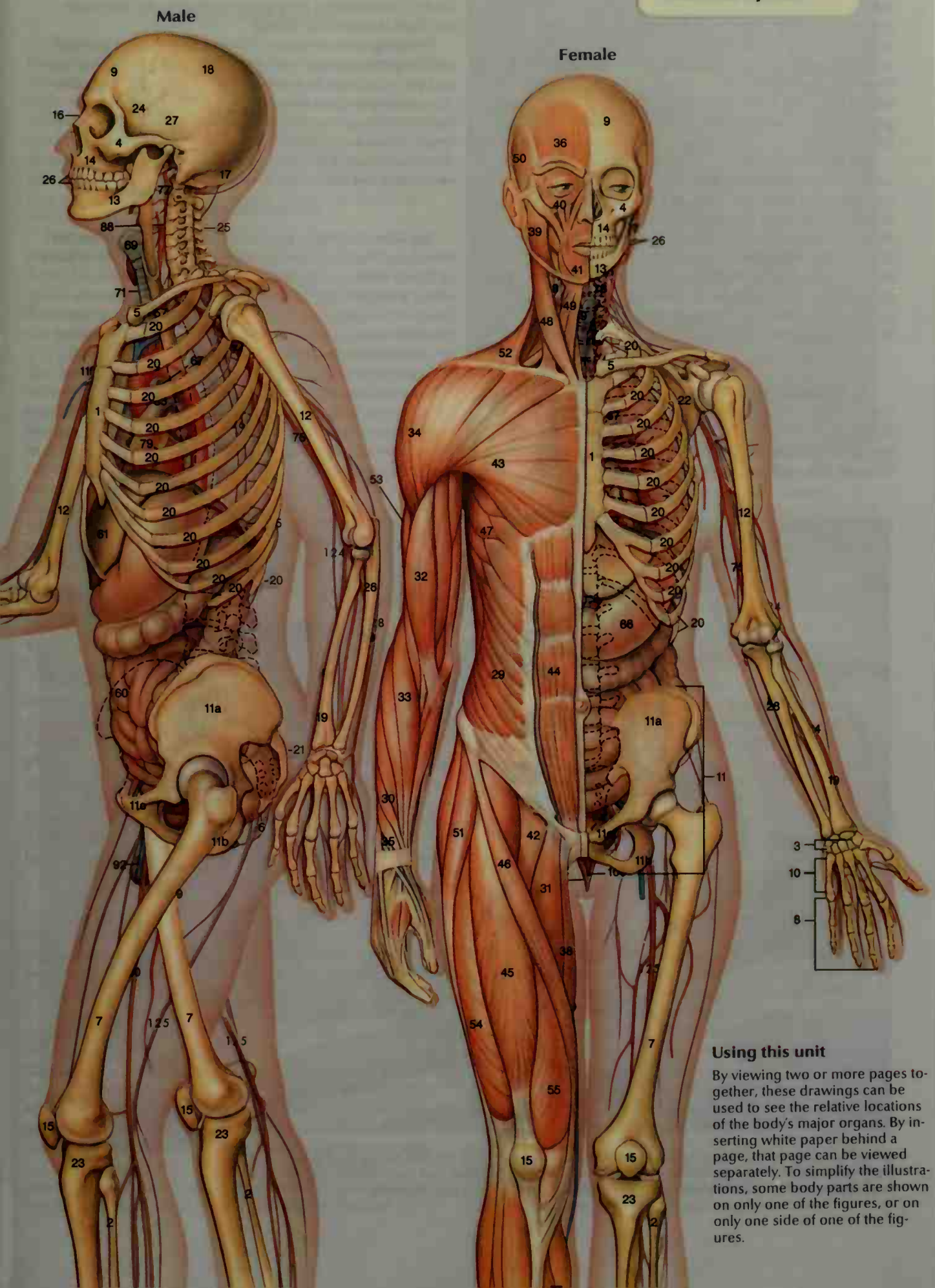
Skeletal System and Muscular System



Using this unit

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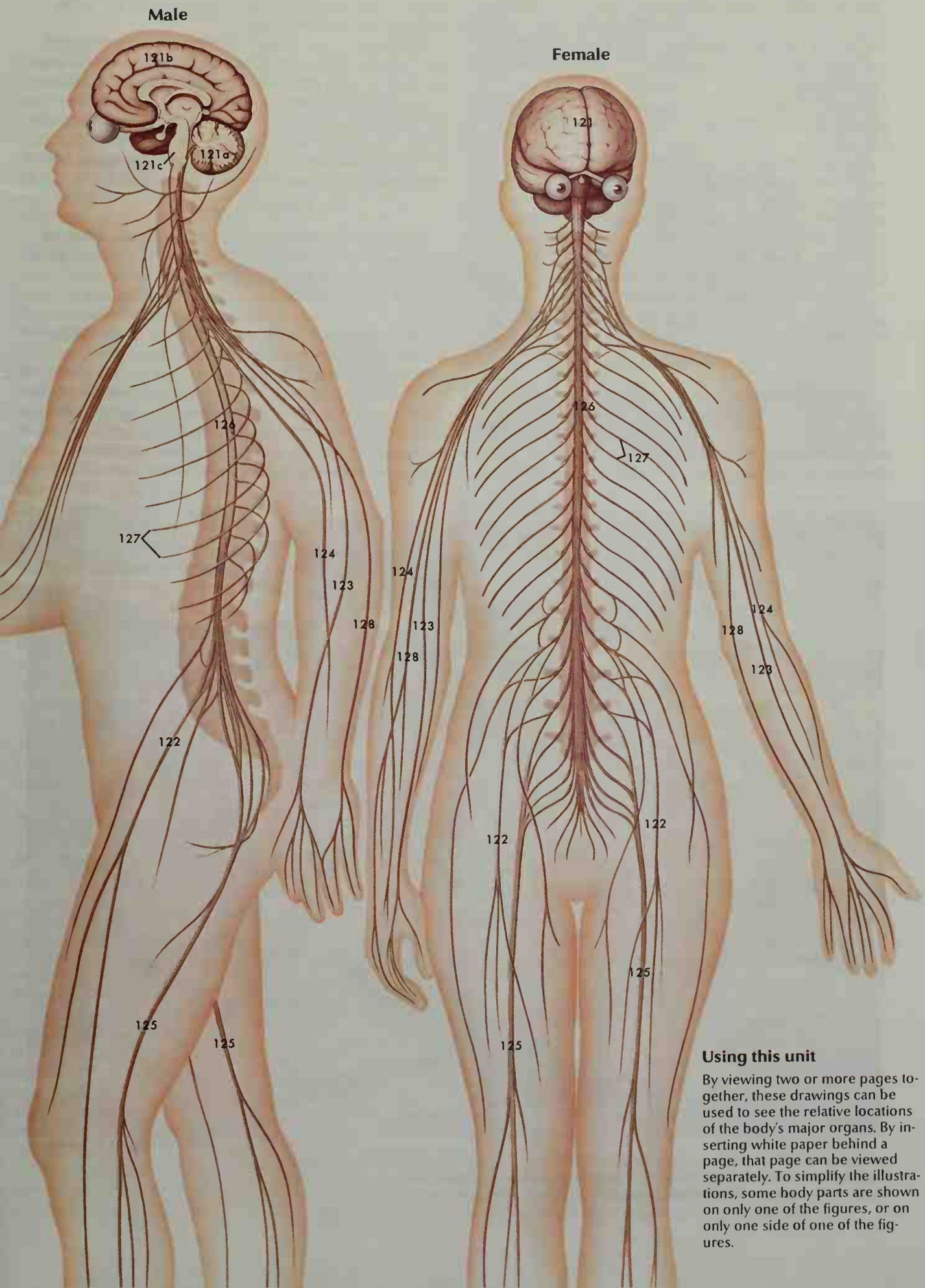
Nervous system



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called *formed elements.* The liquid, which makes up 50 to 60 percent of the total volume of blood, is known as *plasma.* It carries many important substances. The digested food that enters the blood from the intestines and liver dissolves in the plasma, much as sugar dissolves in water. The plasma transports the dissolved food throughout the body. Many of the wastes that the blood picks up from the body tissues are carried in the plasma. These wastes include urea and much of the carbon dioxide.

The formed elements in blood consist of *red blood cells, white blood cells,* and *platelets.* Red blood cells carry oxygen from the lungs to the body tissues. They also carry some of the carbon dioxide from the tissues. White blood cells help protect the body from disease. These cells attack bacteria, viruses, poisons, and other harmful substances. Platelets are disklike structures that help prevent bleeding from damaged blood vessels. Together with various proteins in the plasma, platelets seal broken vessels by forming a clot.

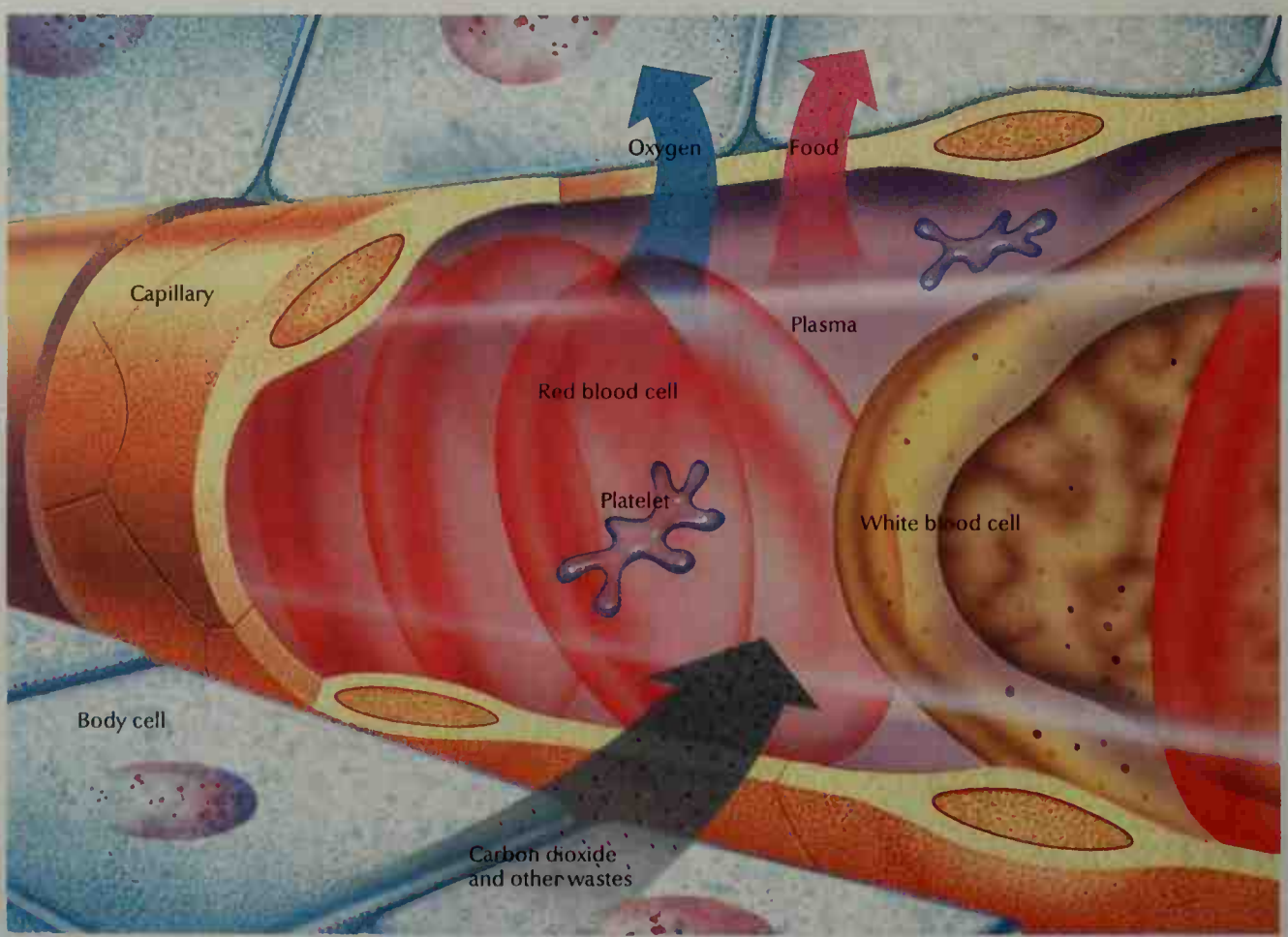
The lymphatic system

The lymphatic system consists of a network of tubes that carries a clear, watery fluid called *lymph.* Lymph comes from the blood and eventually returns to it. Water, proteins, and dissolved food leave the blood through the capillary walls. This fluid, which is known as *interstitial fluid,* bathes and nourishes the cells of the body tissues. The fluid then drains into tiny, closed-ended tubes called *lymphatic capillaries.* At this point, the fluid is known as *lymph.*

The lymph flows through the small tubes into larger and larger lymphatic vessels. *Lymph nodes* occur at various points along the lymphatic vessels. These beadlike structures produce many white blood cells and filter harmful substances out of the lymph. Eventually, all the lymph flows into either the *thoracic duct* or the *right lymphatic duct.* The lymph drains from these ducts into veins near the neck and so rejoins the blood.

The urinary system

The urinary system removes various wastes from the blood and flushes them from the body. The chief organs of this system are the two kidneys. Each kidney has about a million microscopic filtering units known as *nephrons.* As blood passes through a nephron, a complicated network of capillaries and tubes filters out water, and other wastes called *filtrate.* Water and substances important to the body are removed and other substances are excreted to produce a yellowish fluid, called *urine.* Two tubes called *ureters* transport urine from the kidneys to the *urinary bladder,* a hollow storage organ. Urine eventually is squeezed out of the bladder by muscular contractions. It then leaves the



WORLD BOOK illustration by Colin Bidgood

Blood consists of a liquid and three kinds of cells. *Plasma,* the liquid portion, brings food to the body cells, and carries away wastes. *Red blood cells* transport oxygen, and *white blood cells* defend against disease. *Platelets* help prevent bleeding from damaged blood vessels.

body through a tube known as the *urethra.*

The reproductive system

The organs of the reproductive system enable men and women to have children. Human beings reproduce sexually. Sexual reproduction involves the union of sex cells. A new human being begins to develop after a sex cell produced by the father unites with a sex cell produced by the mother. The father's sex cells are called *sperm,* and the mother's are called *eggs.* The union of a sperm and an egg results in *fertilization.* The fertilized egg has all the information necessary for the development of a new human being.

The male reproductive system includes two *testicles,* which hang between the legs in a pouch called the *scrotum.* The testicles are glands that produce sperm. The sperm travel through tubes to the *penis,* an organ in front of the scrotum. Sperm leave a man's body through the penis.

Most of the female reproductive system lies within the woman's body. Deep within the body are two glands called *ovaries,* each of which contains thousands of eggs. Only about 400 eggs will mature during a woman's childbearing years. About once a month, one of the ovaries releases an egg. The egg travels down a narrow duct called the *fallopian tube.* The female body has two fallopian tubes, one leading from each ovary. The fallopian tubes open into the top of the *uterus,* a hollow, muscular organ. The other end of the uterus leads to a canal called the *vagina.* The vagina extends to the outside of the body, opening between the legs.

During sexual intercourse, sperm from the penis enter the vagina. Each sperm has a tiny tail and can swim. The sperm swim from the vagina to the uterus and into the fallopian tubes. If an egg is present in one of the tubes, a sperm may fertilize it.

The fertilized egg continues its journey to the uterus, where it becomes attached to the wall of the organ. The cell divides over and over, forming the developing baby. Soon, a complex organ called the *placenta* forms. The placenta enables the developing baby to obtain food and oxygen from the mother's bloodstream.

After about nine months, the baby is ready to be born. Powerful contractions of the uterus push the baby out through the mother's vagina, which widens to allow the baby to pass through.

The endocrine system

The endocrine system consists of glands that regulate various body functions.The system plays a major role in regulating growth, the reproductive process, and the way the body uses food. It also helps prepare the body to deal with stress and emergencies.

The endocrine glands control body functions by producing hormones. These molecules are released into the blood, which carries them throughout the body. Hormones act as chemical messengers. After a hormone reaches the organs or tissues it affects, it triggers certain actions. Many hormones have widespread effects. For example, the hormone *insulin* causes cells throughout the body to take in and use sugar from the bloodstream.

The chief endocrine glands include the adrenal glands, the pituitary gland, the parathyroid glands, and the thyroid gland. Other endocrine glands include the ovary, testis, thymus, and pineal gland. The brain, the kidneys, the stomach, and the pancreas also have endocrine tissues and produce hormones. The pituitary gland, which lies near the base of the brain, is often called the *master gland.* It releases a number of hormones, which, in turn, regulate other endocrine glands. However, the pituitary itself is controlled by hormones produced by the *hypothalamus,* a part of the brain. The hypothalamus links the nervous and endocrine control systems.

Lennart Nilsson from *Behold Man* © 1974 Little, Brown and Company

One egg cell is released from an ovary about every 28 days during a woman's childbearing years. The egg is surrounded by a covering, which appears as a ring in this photograph. If a sex cell from a man penetrates the covering and unites with the egg, a new human being begins to develop.

The body also has glands that do not produce hormones. These *exocrine glands* make substances that perform specific jobs in the area where they are released. Major exocrine products include the digestive juices, mucus, sweat, and tears.

The nervous system

The nervous system regulates and coordinates the activities of all the other systems of the body. It enables the body to adjust to changes that occur within itself and in its surroundings. The nervous system is made up of countless nerve cells, or *neurons.* The neurons form a communications network that extends to every part of the body. The nervous system has three main divisions. They are (1) the central nervous system; (2) the peripheral nervous system, which includes the eyes, ears, nose, and other sense organs; and (3) the autonomic nervous system.

The central nervous system consists of the brain and spinal cord. It functions as the control center of the nervous system. The central nervous system receives information from the senses. It analyzes this information and decides how the body should respond. It then

sends instructions that trigger the required actions.

The central nervous system makes some simple decisions within the spinal cord, such as directing the hand to pull away from a hot object. Such simple decisions are called *spinal reflexes.* Most decisions, however, involve the brain. The brain is an enormously complicated collection of billions of neurons. These neurons are linked together in precise patterns that enable the brain to think and remember. Much brain activity occurs at the conscious level. We are aware of decisions made at this level and can voluntarily control them. Other activity occurs at the subconscious level. This activity regulates the smooth muscles and is beyond voluntary control.

The peripheral nervous system is made up of the nerves that connect the central nervous system with every part of the body. These nerves include both *sensory neurons,* which carry information to the central nervous system, and *motor neurons,* which relay instructions from the central nervous system.

Sensory neurons run between the sense organs and the central nervous system. The sense organs have special cells called *receptors.* Receptors translate information about the internal or external environment into nerve impulses. These impulses are electrical signals that nerves can carry.

The body has many kinds of sense receptors. Vision receptors in the eyes change light waves into nerve impulses. Hearing receptors in the ears convert sound waves into nerve impulses. Smell receptors in the nose and taste receptors on the tongue convert chemical information into nerve impulses. Receptors in the skin respond to heat, cold, pressure, touch, and pain. Receptors deep within the body provide information on the chemical and physical conditions of inner body tissues.

Nerve impulses from the sense receptors travel along sensory neurons to the central nervous system. The central nervous system analyzes the information and decides what actions, if any, are necessary. If a response is needed, the central nervous system sends out instructions. The motor neurons of the peripheral nervous system carry the instructions from the central nervous system to the appropriate tissues.

The autonomic nervous system is a special part of the peripheral nervous system. It carries messages from the subconscious level of the brain to the internal organs. The autonomic nervous system regulates the automatic functions of the body, such as the beating of the heart and the movement of food through the digestive system.

John R. Conway III

Related articles in *World Book* include:

Muscular and skeletal systems

Achilles tendon	Collarbone	Knee	Rib
Ankle	Elbow	Leg	Shoulder
Arm	Foot	Ligament	Skeleton
Back	Hand	Mastoid	Skull
Bone	Head	Muscle	Spine
Cartilage	Hip	Palate	Tendon
	Joint	Pelvis	

Digestive system

Alimentary canal	Enzyme	Liver
Assimilation	Esophagus	Mastication
Bile	Gallbladder	Mouth
Colon	Hunger	Pancreas
Digestive system	Intestine	Pepsin
Pharynx	Saliva	Stomach
Teeth		

Respiratory system

Chest	Larynx	Nose	Respiration
Diaphragm	Lung	Pleura	Trachea

Circulatory system

Aorta	Circulatory system	Lymphatic system
Artery	Corpuscle	Spleen
Blood	Heart	Vein
Capillary	Jugular vein	

Reproductive system

Baby	Ovary	Sexuality
Embryology	Penis	Sterility
Fallopian tube	Placenta	Testicle
Fertilization	Pregnancy	Umbilical cord
Impotence	Reproduction, Human	Uterus
Menstruation		Vagina

Endocrine system

ACTH	Gland	Parathyroid gland
Adrenal gland	Hormone	Pineal gland
Epinephrine	Insulin	Pituitary gland
Estrogen	Pancreas	Thyroid gland

Nervous system

Brain	Funny bone	Senses
Cerebrospinal fluid	Nervous system	Smell
	Pain	Solar plexus
Ear	Perception	Taste
Eye	Reflex action	Touch

Other related articles

Abdomen	Elimination	Nail
Anatomy	Growth	Physical fitness
Appendix	Hair	Physiology
Biological clock	Health	Posture
Biology	Human being	Prostaglandin
Bladder	Kidney	Skin
Breast	Life	Throat
Connective tissue	Medicine	Transplant (medicine)
Disease	Metabolism	

Outline

I. What the body is made of
- A. Chemical elements and molecules
- B. Cells and tissues
- C. Organs and organ systems

II. The skin
- A. The epidermis
- B. The dermis
- C. Subcutaneous tissues

III. The skeletal system

IV. The muscular system
- A. Skeletal muscles
- B. Smooth muscles
- C. Cardiac muscle

V. The digestive system
- A. The mouth, esophagus, and stomach
- B. The small intestine and large intestine

VI. The respiratory system
- A. The air passages
- B. The exchange of carbon dioxide and oxygen

VII. The circulatory system
- A. The heart
- B. The blood vessels
- C. The blood

VIII. The lymphatic system

IX. The urinary system

X. The reproductive system

XI. The endocrine system

XII. The nervous system
- A. The central nervous system
- B. The peripheral nervous system
- C. The autonomic nervous system

Questions

How much of the human body consists of water?

What are the two main jobs of the respiratory system?
How do the salivary glands aid in digestion?
What role do receptors play in the nervous system?
In what ways can the human body be compared to a machine? How does it differ from one?
Why are capillaries important in the circulatory system?
How does the skin help keep the temperature of the body within its normal range?
Why is the pituitary gland called the master gland?
What are the four chief kinds of tissues in the human body?
What are the most common chemical elements in the human body?

Additional resources

Level I

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Level II

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Human engineering. See Ergonomics.

Human Genome Project is an international scientific program to analyze the complete chemical instructions that control heredity in human beings. One complete set of these instructions is called a *genome* (*JEE nohm*). The Human Genome Project also aims to analyze the genomes of other organisms, including the house mouse, whose scientific name is *Mus musculus*; the fruit fly, known scientifically as *Drosophila melanogaster*; and a roundworm called *Caenorhabditis elegans*.

All living things contain hereditary instructions of the kind that researchers are analyzing in the Human Genome Project. These instructions are carried on long coils of a chemical called DNA (*d*eoxyribo*n*ucleic *a*cid). DNA contains four types of simpler chemicals called *bases*. The four types of bases are cytosine (C), adenine (A), guanine (G), and thymine (T). Experts estimate that the human genome contains about 3 billion of these bases.

Scientists are sharing information to determine the exact arrangement of bases in living organisms' genomes. This process is called *sequencing*. Although bases can combine chemically in any order, they occur in almost the same order in all human beings or all the members of any other particular species. In any two human genomes, only about one base in one thousand differs.

These slight variations in genomes control the inherited aspects of many of the ways that people differ from one another. For example, some variations produce differences in eye color, skin color, and blood type. Others contribute to differences in height, weight, and many other characteristics. Still other variations may cause certain abnormalities or significantly increase the likelihood that individuals will get a particular disease.

Instructions for a specific characteristic are encoded in one or more sections of bases called *genes*. In human beings, genes are arranged on 23 pairs of rod-shaped structures called *chromosomes*. Scientists expect that identifying the sequence of bases in the human genome will serve as the first step in developing highly detailed *gene maps*. These maps will show where each gene lies on a chromosome. After scientists have identified each gene's location, a further goal will be to determine each gene's role in normal body processes or in disease.

The Human Genome Project began formally in 1990. In 1998, scientists completed sequencing of the roundworm *Caenorhabditis elegans*. *C. elegans* is the first multicellular organism to have its entire genome sequenced. In 1999, scientists completed sequencing of the human chromosome designated number 22. Scientists determined the order of over 33 million bases that make up over 700 genes on chromosome 22. This was the first of the 23 pairs of human chromosomes to be sequenced. In June 2000, the Human Genome Project and Celera Genomics Corporation, a private company, announced that together they had sequenced essentially the entire human genome. The following year, American and British scientists used these findings to determine that the human genome has about 40,000 genes, far less than previously believed. The scientists also found that humans share many genes with such primitive organisms as bacteria.

Knowledge gained in the Human Genome Project may one day enable experts to analyze individual differences among genomes. Because genetic variations cause or contribute to certain diseases, analysis of a person's genome could reveal health information that should remain private. Scientists are studying how to prevent misuse of such information. Maynard V. Olson

See also Cell; DNA; Gene; Gene mapping; Heredity.

Human immunodeficiency virus. See AIDS (Cause).

Human relations is a field of study that deals with group behavior. Experts in human relations seek to discover the best means of achieving desired goals with a minimum of conflict. Human dignity and respect for the individual are considered basic. Human relations assumes that each individual has certain needs, but that people differ in what they consider important. Human relations also assumes that a person joins a group to get something from it, and that the group in turn expects a contribution from each member.

The basic elements in human relations

Individual needs. Individuals have two kinds of needs: inborn and acquired. *Inborn needs* include food, water, and rest. *Acquired needs* are learned from others and may be just as real as inborn needs. For example, a person may reduce spending on meals (inborn need) to meet the payments on a new car (acquired need).

Human relations experts must know why people act as they do, how they react to different situations, and what will make them change their minds. Experts study the economic, sociological, psychological, religious, and political motivations that cause human actions.

Living together. Each individual lives in contact with others because people are social beings. A person's first group usually is his or her immediate family—parents, sisters, and brothers. In most societies, individuals also participate in a large group of other close relatives.

Children first learn to live with their family and playmates. As they grow, their activities may center around their church, friends, age group at school, or special interests and hobbies. Adults may surround themselves with their own family or belong to a labor union, political party, or a lodge. Everyone joins temporary groups, such as concert audiences or shopping crowds.

Group conflicts. Every group situation provides opportunities for conflict between the needs of the various members of the group. For example, a building contractor may want to work overtime to finish a job. But the laborers may want to quit on time and go home to their families. In many cases of conflict, satisfying the wants of one person will automatically frustrate the wants of another. If the laborers go on strike, human relations have broken down. To prevent this, the people involved must find some way to maintain human relations by mutual accommodation.

Most groups have certain formal and informal regulations that minimize misunderstandings and conflicts. Each member of the group is expected to learn and follow these rules. People often learn the norms of the group so thoroughly that they are hardly aware of them. On the basis of accepted rules, group members can predict the behavior of their fellows. Without accepted norms, people are uncertain about what is expected of them, and the group may easily dissolve.

Conflict between individuals and groups is not always troublesome. Sometimes it increases the unity on each opposing side, reduces tensions, and clarifies the objectives of the individual and the organization.

Leadership is important in keeping the group working together and directing it to act in a certain way. Leadership skill is particularly important when conflicts arise. Leaders must use all their human relations skills to accommodate conflicting interests within their group. A group usually responds to its leader because it respects the leader's wisdom or experience or agrees with his or her opinion.

Human relations in action

Background information. Human relations depends on the contributions of the social sciences. Economists study the relationships of people as they produce and distribute goods and services. Political scientists compile knowledge about the behavior of people attempting to maintain order. Cultural anthropologists compare ways of living in various societies. Social psychologists concentrate on the ways in which group life molds the individual's attitudes and personality. Sociologists study the structure of social life and the ways in which groups are formed and function.

Programs in human relations vary according to the situation. But each program in human relations must take into account the basic goals of the group and other factors such as the organizational units and the system of control. The *organizational units* include the formal structure and the informal structure within the organization, and any outside influences that might have an effect on orderly group processes. The *system of control* includes all the elements (attitudes, motivations, and organizational units) guiding the actions of people in a certain situation.

Many school systems have introduced programs of intercultural education, an outstanding example of human relations in action. These programs try to reduce friction between people of varying backgrounds who live and work in close contact. Human relations programs also play an important role in many industrial firms. Since the 1940's, many employers have revised their attitudes about employees. They no longer regard an employee as just another pair of "hands," but as a personality with individual wants that the employer must take into account.

Raymond W. Mack

Related articles in *World Book* include:

Alienation
Assimilation
Group dynamics
Industrial relations
Minority group
Segregation
Social psychology
Social role

Human rights are those rights that each person is entitled to simply because he or she is a human being. The concept of human rights is based on the idea that each person has worth and dignity, and thus deserves certain basic freedoms. When these freedoms are recognized, each individual can enjoy safety, security, and the ability to make many decisions about his or her life.

The laws and court systems of most nations are designed to protect human rights. But national systems are not always effective, and many fail to acknowledge certain human rights. Today, international standards help to ensure human rights when national governments do not.

Most of the international laws that define and guarantee human rights were developed by the United Nations (UN), an organization dedicated to worldwide peace and security. Almost every independent country in the world belongs to the UN. Thus, the UN joins most of the world into an international community.

The world's societies also have contact with one another through trade; through culture; and through such media as newspapers, television, and the Internet. This connectedness, sometimes called *globalization,* helps spread human rights awareness throughout the world. Furthermore, violations of human rights are now more likely to be exposed, and the UN and other organizations are more capable of combating those violations.

Types of human rights

Human rights can be classified into three main types: (1) rights of personal integrity, (2) civil liberties, and (3) social and economic rights. *Rights of personal integrity* involve rights to personal safety and freedom. These include freedom from slavery, torture, and unreasonable imprisonment. *Civil liberties* are the rights of each person to express beliefs through words and actions. These rights include freedoms of speech, association, thought, conscience, and religion. Other civil liberties include the right to vote and run for office, and the right to marry and have a family. *Social and economic rights* involve basic human needs and rights of development. These include the right to food, shelter, medical care, and education; and the right to work and to form labor unions.

The development of human rights

Efforts to establish basic rights began hundreds or even thousands of years ago. One important early document in these efforts was Magna Carta of 1215, which granted rights to individuals and ensured that England's king would be subject to the law. Magna Carta became a model for later documents, such as the United States Constitution's Bill of Rights, adopted in 1791. The Bill of Rights suggested the idea of universal rights, but in practice, it excluded slaves and certain other groups. It was not truly universal, and thus it failed to address human rights as we now understand them. By the early

1900's, however, people around the world had begun to form international communities, such as the International Labour Organization in 1919, to work for basic rights all over the world.

Modern ideas of human rights began to take shape following World War II (1939-1945) and the Holocaust, the systematic murder of Jews and others by Germany's Nazi government. The Holocaust forced world leaders to reconsider the traditional notion of *national sovereignty,* which holds that a nation's government is the ultimate legal authority within that country. In the Nuremberg Trials, which began in 1945, the war's victors charged Nazi leaders with war crimes, crimes against humanity, and other offenses. These trials showed that international standards could outweigh national sovereignty when human rights were violated on a massive scale.

Also in 1945, independent countries responded to World War II by forming the UN. The Charter of the United Nations, the UN's constitution, was one of the first international human rights documents. The charter forbids discrimination on the basis of race, sex, language, or religion. But because the charter contains no specific list of human rights, the UN began to draft the Universal Declaration of Human Rights, which was adopted on Dec. 10, 1948. This document sets forth the basic civil, political, economic, social, and cultural rights of every person. See **Human Rights, Universal Declaration of.**

The UN's role in protecting human rights

Treaties. United Nations positions on human rights establish principles that can help to shape laws and practices within countries. The United Nations may also adopt treaties to give legal force to its positions. Human rights treaties are drafted by the UN Commission on Human Rights and adopted by the General Assembly of the United Nations.

In 1966, the UN adopted the International Covenant on Civil and Political Rights and the International Covenant on Economic, Social, and Cultural Rights. These treaties give legal protection to many rights outlined in the Universal Declaration. Since then, treaties have addressed such issues as the treatment of prisoners, the status of refugees, women's rights, and the rights of the child.

Relief and other assistance. Sometimes, a country is unable to provide for the most basic human rights. In such cases, UN relief efforts provide food, shelter, medical supplies, and other support.

In its early years, the UN Commission on Human Rights focused mainly on responding to human rights abuses. Today, the commission emphasizes education and other assistance to create governmental structures that can prevent human rights abuses. Today, many nations benefit from UN aid in the form of educational programs and technical specialists. Specialists include legal and other experts to oversee elections or provide training of prison officials and police officers.

Monitoring. UN committees called *treaty bodies* monitor international enforcement of specific human rights treaties. When the UN suspects violations, it may appoint a group or individual to study and report on the situation. UN reports can expose a problem, which can then lead to international pressure on a government to resolve that problem with UN assistance.

Trade and diplomatic measures. Sometimes, a government willfully, systematically violates human rights. Such governments may refuse to cooperate with UN diplomatic efforts to protect human rights. In rare cases, the UN may recommend *sanctions* (penalties) against an offending country. During sanctions, other nations restrict trade and diplomatic relations with the country.

Sanctions can be effective, but they may be slow to work. In 1962, the UN advised sanctions against South Africa in response to *apartheid,* a governmental system of racial segregation. In 1991, after years of sanctions and other pressures, the South African government repealed the last apartheid laws. Many critics argue, however, that sanctions can harm a country's civilian population without bringing about the desired change in its governmental practices.

Peacekeeping. Human rights violations may become widespread in times of civil unrest and in armed conflicts between regions. When regional governments cannot maintain order, the UN may approve military presence in an area. Normally, the UN sends peacekeeping troops with the consent of the opposing parties. In 1999, the people of the disputed territory East Timor voted for independence in a UN-sponsored election. Anti-independence militias then began a campaign of violence against the East Timorese. With the approval of Indonesia's government, the UN sent troops to restore order.

Criminal trials. In many conflicts, military leaders use human rights violations against civilians as a strategy of war. In the 1990's, the UN responded to many of these abuses by organizing trials of war criminals in Rwanda and in areas of the former Yugoslavia.

Other human rights organizations

Regional governmental bodies are often important for protecting human rights within a region. Such systems exist in the Arab League, the Council of Europe, and the Organization of American States.

Independent organizations, such as Amnesty International and Human Rights Watch, help to influence public opinion and legal standards worldwide. They play a crucial role in calling attention to human rights abuses. For example, investigations by Amnesty International exposed the problem of Argentine disappearances in the 1970's and 1980's. During that period, thousands of opponents of Argentina's military dictatorship vanished, probably murdered by authorities. These findings led to further UN study of the problem.

Human rights and cultural differences

People who allow or commit human rights violations sometimes claim that international standards—or their enforcement—intrude upon traditional practices within their culture. And UN treaties do protect cultural rights. Yet those protections do not apply to any practice or incident that violates another person's human rights. Victims of human rights violations do not see international standards as conflicting with their culture. In many cases, they actively oppose the laws or leaders who allow human rights abuses. In all parts of the world, human

rights principles can be absorbed and reinforced by existing traditions within cultures. Dinah L. Shelton

Related articles in *World Book* include:

Amnesty International
Child labor
Civil rights
Freedom
Helsinki Accords
Human Rights Watch
Political prisoner
United Nations (Human rights)
United Nations Commission on Human Rights
War crime
Women's movements

Additional resources

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Peck, Rodney G. *Working Together Against Human Rights Violations.* Rosen Pub. Group, 1995.
Perry, Michael J. *The Idea of Human Rights.* Oxford, 1998.

Human Rights, Universal Declaration of, is a document adopted by the United Nations (UN) General Assembly on Dec. 10, 1948. It was designed to protect people throughout the world from abuses of power. The declaration was drafted by a multinational committee that included Eleanor Roosevelt of the United States, René-Samuel Cassin of France, and Charles Malik of Lebanon. The committee was supported by many religious groups, civil rights organizations, and well-known individuals.

The Universal Declaration of Human Rights sets forth basic civil, political, economic, social, and cultural rights and freedoms. It emphasizes equality and nondiscrimination. The declaration is not a treaty. However, it provides a common understanding of the rights and freedoms that every UN member state should promote and observe.

The declaration's provisions have influenced many national constitutions since 1948. The declaration has helped foster the independence of former colonies and has helped lead some states and regions toward democracy. It has also led to numerous treaties to protect human rights. Dinah L. Shelton

See also Civil rights (Civil rights today); Human rights; United Nations (Human rights); United Nations Commission on Human Rights.

Universal Declaration of Human Rights

Preamble

Whereas recognition of the inherent dignity and of the equal and inalienable rights of all members of the human family is the foundation of freedom, justice and peace in the world,
Whereas disregard and contempt for human rights have resulted in barbarous acts which have outraged the conscience of mankind, and the advent of a world in which human beings shall enjoy freedom of speech and belief and freedom from fear and want has been proclaimed as the highest aspiration of the common people,
Whereas it is essential, if man is not to be compelled to have recourse, as a last resort, to rebellion against tyranny and oppression, that human rights should be protected by the rule of law,
Whereas it is essential to promote the development of friendly relations between nations,
Whereas the peoples of the United Nations have in the Charter reaffirmed their faith in fundamental human rights, in the dignity and worth of the human person and in the equal rights of men and women and have determined to promote social progress and better standards of life in larger freedom,
Whereas Member States have pledged themselves to achieve, in co-operation with the United Nations, the promotion of universal respect for and observance of human rights and fundamental freedoms, Whereas a common understanding of these rights and freedoms is of the greatest importance for the full realization of this pledge,

Now, therefore,
The General Assembly
proclaims this

Universal Declaration of Human Rights as a common standard of achievement for all peoples and all nations, to the end that every individual and every organ of society, keeping this Declaration constantly in mind, shall strive by teaching and education to promote respect for these rights and freedoms and by progressive measures, national and international, to secure their universal and effective recognition and observance, both among the peoples of Member States themselves and among the peoples of territories under their jurisdiction.

Article 1

All human beings are born free and equal in dignity and rights. They are endowed with reason and conscience and should act towards one another in a spirit of brotherhood.

Article 2

Everyone is entitled to all the rights and freedoms set forth in this Declaration, without distinction of any kind, such as race, colour, sex, language, religion, political or other opinion, national or social origin, property, birth or other status. Furthermore, no distinction shall be made on the basis of the political, jurisdictional or international status of the country or territory to which a person belongs, whether it be independent, trust, nonself-governing or under any other limitation of sovereignty.

Article 3

Everyone has the right to life, liberty and security of person.

Article 4

No one shall be held in slavery or servitude; slavery and the slave trade shall be prohibited in all their forms.

Article 5

No one shall be subjected to torture or to cruel, inhuman or degrading treatment or punishment.

Article 6

Everyone has the right to recognition everywhere as a person before the law.

Article 7

All are equal before the law and are entitled without any discrimination to equal protection of the law. All are entitled to equal protection against any discrimination in violation of this Declaration and against any incitement to such discrimination.

Article 8

Everyone has the right to an effective remedy by the

competent national tribunals for acts violating the fundamental rights granted him by the constitution or by law.

Article 9

No one shall be subjected to arbitrary arrest, detention or exile.

Article 10

Everyone is entitled in full equality to a fair and public hearing by an independent and impartial tribunal, in the determination of his rights and obligations and of any criminal charge against him.

Article 11

1. Everyone charged with a penal offence has the right to be presumed innocent until proved guilty according to law in a public trial at which he has had all the guarantees necessary for his defence.
2. No one shall be held guilty of any penal offence on account of any act or omission which did not constitute a penal offence, under national or international law, at the time when it was committed. Nor shall a heavier penalty be imposed than the one that was applicable at the time the penal offence was committed.

Article 12

No one shall be subjected to arbitrary interference with his privacy, family, home or correspondence, nor to attacks upon his honour and reputation. Everyone has the right to the protection of the law against such interference or attacks.

Article 13

1. Everyone has the right to freedom of movement and residence within the borders of each state.
2. Everyone has the right to leave any country, including his own, and to return to his country.

Article 14

1. Everyone has the right to seek and to enjoy in other countries asylum from persecution.
2. This right may not be invoked in the case of prosecutions genuinely arising from non-political crimes or from acts contrary to the purposes and principles of the United Nations.

Article 15

1. Everyone has the right to a nationality.
2. No one shall be arbitrarily deprived of his nationality nor denied the right to change his nationality.

Article 16

1. Men and women of full age, without any limitation due to race, nationality or religion, have the right to marry and to found a family. They are entitled to equal rights as to marriage, during marriage and at its dissolution.
2. Marriage shall be entered into only with the free and full consent of the intending spouses.
3. The family is the natural and fundamental group unit of society and is entitled to protection by society and the State.

Article 17

1. Everyone has the right to own property alone as well as in association with others.
2. No one shall be arbitrarily deprived of his property.

Article 18

Everyone has the right to freedom of thought, conscience and religion; this right includes freedom to change his religion or belief, and freedom, either alone or in community with others and in public or private, to manifest his religion or belief in teaching, practice, worship and observance.

Article 19

Everyone has the right to freedom of opinion and expression; this right includes freedom to hold opinions without interference and to seek, receive and impart information and ideas through any media and regardless of frontiers.

Article 20

1. Everyone has the right to freedom of peaceful assembly and association.
2. No one may be compelled to belong to an association.

Article 21

1. Everyone has the right to take part in the government of his country, directly or through freely chosen representatives.
2. Everyone has the right of equal access to public service in his country.
3. The will of the people shall be the basis of the authority of government; this will shall be expressed in periodic and genuine elections which shall be by universal and equal suffrage and shall be held by secret vote or by equivalent free voting procedures.

Article 22

Everyone, as a member of society, has the right to social security and is entitled to realization, through national effort and international co-operation and in accordance with the organization and resources of each State, of the economic, social and cultural rights indispensable for his dignity and the free development of his personality.

Article 23

1. Everyone has the right to work, to free choice of employment, to just and favourable conditions of work and to protection against unemployment.
2. Everyone, without any discrimination, has the right to equal pay for equal work.
3. Everyone who works has the right to just and favourable remuneration ensuring for himself and his family an existence worthy of human dignity, and supplemented, if necessary, by other means of social protection.
4. Everyone has the right to form and to join trade unions for the protection of his interests.

Article 24

Everyone has the right to rest and leisure, including reasonable limitation of working hours and periodic holidays with pay.

Article 25

1. Everyone has the right to a standard of living adequate for the health and well-being of himself and of his family, including food, clothing, housing and medical care and necessary social services, and the right to security in the event of unemployment, sickness, disability, widowhood, old age or other lack of livelihood in circumstances beyond his control.

2. Motherhood and childhood are entitled to special care and assistance. All children, whether born in or out of wedlock, shall enjoy the same social protection.

Article 26

1. Everyone has the right to education. Education shall be free, at least in the elementary and fundamental stages. Elementary education shall be compulsory. Technical and professional education shall be made generally available and higher education shall be equally accessible to all on the basis of merit.

2. Education shall be directed to the full development of the human personality and to the strengthening of respect for human rights and fundamental freedoms. It shall promote understanding, tolerance and friendship among all nations, racial or religious groups, and shall further the activities of the United Nations for the maintenance of peace.

3. Parents have a prior right to choose the kind of education that shall be given to their children.

Article 27

1. Everyone has the right freely to participate in the cultural life of the community, to enjoy the arts and to share in scientific advancement and its benefits.

2. Everyone has the right to the protection of the moral and material interests resulting from any scientific, literary or artistic production of which he is the author.

Article 28

Everyone is entitled to a social and international order in which the rights and freedoms set forth in this Declaration can be fully realized.

Article 29

1. Everyone has duties to the community in which alone the free and full development of his personality is possible.

2. In the exercise of his rights and freedoms, everyone shall be subject only to such limitations as are determined by law solely for the purpose of securing due recognition and respect for the rights and freedoms of others and of meeting the just requirements of morality, public order and the general welfare in a democratic society.

3. These rights and freedoms may in no case be exercised contrary to the purposes and principles of the United Nations.

Article 30

Nothing in this Declaration may be interpreted as implying for any State, group or person any right to engage in any activity or to perform any act aimed at the destruction of any of the rights and freedoms set forth herein.

Human Rights Watch is an organization dedicated to promoting and protecting the rights and freedoms of people throughout the world. It investigates charges of human rights abuses and publishes dozens of reports every year based on its investigations.

Human Rights Watch uses the media to draw attention to human rights problems and to pressure governments, armed groups, and corporations to stop abuse. The organization is funded by private individuals and foundations, and it accepts no government contributions.

Human Rights Watch was founded in 1978 as Helsinki Watch. Its original purpose was to monitor compliance with the 1975 Helsinki Accords. In those agreements, the Soviet Union and other countries promised to respect the rights of their citizens. Helsinki Watch gradually widened its scope and in 1988 changed its name to Human Rights Watch.

Today, the organization has eight divisions. These divisions focus on the following areas of concern: Africa, the Americas, Asia, Europe and Central Asia, the Middle East and North Africa, women's rights, children's rights, and the flow of weapons to rights violators.

Human Rights Watch has headquarters in New York City. It also maintains offices in Brussels, Belgium; London; Hong Kong, China; Moscow; Rio de Janeiro, Brazil; Washington, D.C.; and other cities.

Critically reviewed by Human Rights Watch

See also **Human rights.**

Humane society is a group dedicated to protecting children and animals from human cruelty. Today, a person who sees an animal beaten or a child mistreated may notify the local humane society. The society takes legal action against the offender.

The first humane societies were founded in the 1700's to teach people lifesaving methods and to prevent drownings. The first society to be established for the prevention of cruelty to animals was founded in England in 1824.

The first American Society for the Prevention of Cruelty to Animals was founded in New York in 1866. The New York Society for the Prevention of Cruelty to Children was organized in 1876. Philanthropist Henry Bergh took a leading part in organizing both of these societies. Similar societies were formed throughout the United States. In 1877, these local groups formed the American Humane Association. See also **Society for the Prevention of Cruelty to Animals.**

Critically reviewed by the American Humane Association

Humanism was a cultural movement that flourished in Europe from the 1300's to the 1500's. The movement, which began in Italy, helped characterize the Renaissance, an age of reborn interest in the arts, education, and the classical culture of ancient Greece and Rome.

Humanism was a program of study rather than a unified philosophy. It stressed the *studia humanitatis,* or *humanities,* which included grammar, *rhetoric* (the art of persuasive argument), poetry, history, and moral philosophy. It was designed to make the Christian well-rounded and virtuous.

The word *humanism* may also mean any way of viewing the world that stresses the importance of human be-

ings. This article discusses humanism as a historical movement.

The development of humanism. The humanists' reliance on rhetoric and classical literature had its origins in medieval culture. Medieval theologians known as *scholastics* read both Greek and Roman authors, and they—like the later humanists—hoped to achieve the style of the best Latin writers. Unlike the humanists, however, the scholastics studied logic and grammar as a means to better understand God. They did not believe that Christians could best learn virtue from pagan writers. In addition, in the Middle Ages, the classics were read primarily in the secluded monasteries. Humanism brought the classics out of the monasteries and religious schools and into the *secular* (nonreligious) schools and palaces of the bustling cities.

The first great Italian Renaissance humanist was the poet and scholar Petrarch. Scholars of Petrarch's time first used the term *Middle Ages* to refer to the gulf between their time and the ancient world, which they saw as a golden age of virtue and learning. See **Petrarch.**

By the 1400's, rulers and merchants throughout Italy were hiring humanists as teachers for their children. For example, in Florence, such humanists as Marsilio Ficino and Angelo Poliziano served as tutors or advisers to the Medici, the banking family that ruled the city. Many popes in the 1400's and 1500's had been trained by humanists and employed them. Such women as Isabella d'Este, a patron of art and music in Mantua, also played an active role in the movement.

The spread of humanism. By the late 1400's, intellectuals from northern Europe had begun to travel to Italy to study with leading humanists. After returning home, many combined their Italian-learned humanism with their own cultural traditions. German humanists rediscovered medieval German literature. French humanists worked to make their language as eloquent as Latin had been in the hands of the Romans. François Rabelais enriched the French language in works like *Gargantua and Pantagruel* (1532-1564), which also contains a model humanist program of education. In England, humanism is seen in the works of the statesman and scholar Saint Thomas More. Members of the royal family, including King Henry VIII and his daughter Queen Elizabeth I, received humanist educations. Humanism also had a strong impact on the development of the Renaissance in areas from Spain to Poland.

Many northern humanists have been called *Christian humanists* because of their emphasis on blending humanist and religious study. The Dutch priest Desiderius Erasmus was the most important Christian humanist. He criticized the corruption he saw in the Roman Catholic Church and applied humanist scholarship to writings like the Bible. Erasmus's *In Praise of Folly* (1511) satirized society and the church, and upheld education as the solution to social and spiritual ills.

Work of the humanists. Humanists undertook an extensive search for classical manuscripts, and they found many in obscure monasteries. Humanists knew that many ancient texts had accumulated errors through having been recopied many times over the centuries. They applied their knowledge of *philology* (the study of language) and history to the texts to restore them. Many humanists turned this critical eye toward society and its institutions, becoming critics of political tyranny and church corruption. In the early 1400's, a movement called *civic humanism* declared that educated individuals must lead an active life, using their learning to help their homeland.

By the mid-1400's, humanists had become interested in the ideas of the Greek philosopher Plato. *Neoplatonism,* as the revival of these ideas was called, seemed to offer a way to unify all knowledge. Some humanists embraced the Platonic idea that all knowledge is part of one great and perfect Truth. They attempted to reconcile Christianity with magic or other religions.

A few courageous humanists defended the idea of religious toleration at a time when such toleration was almost unknown. The German Johann Reuchlin became the greatest Christian scholar of Hebrew literature and defended Jewish writings against attempts to burn them.

Humanism and the arts. Humanism, although mainly a literary movement, also had a strong impact on the other arts. Architects sought inspiration from the mathematical proportions of Greek and Roman architecture and produced buildings of great harmony. Under humanism's influence, the pointed arches, elaborate facades, and soaring heights of Gothic architecture gave way to the domes, classical facades, and rounded arches of Renaissance structures.

The painter Masaccio and sculptor Donatello studied Roman art and produced works proudly depicting the human body as beautiful. Renaissance portraiture, influenced by Roman sculpture, took a new interest in presenting individuals as they really appeared. Michelangelo combined the realism of classical sculpture with Biblical themes.

Later influence. Humanism had a major impact on the Reformation of the 1500's, and on the scientific revolution and Age of Reason of the 1600's and 1700's. Humanism's emphasis on a liberal education and the well-rounded individual has made a permanent contribution to the modern world. Today, some people use the term *secular humanism* to describe a philosophy whose value systems depend on human rather than spiritual standards.

Carol Bresnahan Menning

See **Renaissance** with its list of *Related articles.* See also **Education** (The Renaissance); **German literature** (The Renaissance); **History** (The Humanist movement); **Italian literature** (Humanism and the Renaissance); **Middle Ages** (The growth of humanism).

Additional resources

Bullock, Alan. *The Humanist Tradition in the West.* Norton, 1985.
Kekewich, Lucille, ed. *Impact of Humanism.* Yale, 2000.
Kelley, Donald R. *Renaissance Humanism.* Twayne, 1991.
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Humber, River, in England, flows eastward through the county of Humberside and empties into the North Sea. For the location of the River Humber, see **England** (terrain map). The Humber is about 40 miles (64 kilometers) long and from 1 to 7 miles (1.6 to 11 kilometers) wide. The Ouse and Trent rivers, two important trade routes, empty into the River Humber. Large ships can sail up the length of the Humber. Hull and Grimsby are important cities on the banks of the River Humber. When the Vikings invaded England in the 800's and 900's, they sailed their boats up the River Humber.

The Humber Bridge, completed in 1981, crosses the river near Hull. It has one of the longest main spans of any suspension bridge in the world. Its main span measures 4,626 feet (1,410 meters). M. Trevor Wild

Humboldt, *HUHM bohlt,* **Baron von** (1769-1859), a German scientist, was a founder of modern geography. He made important contributions to plant geography, the study of the earth's magnetism, and climatology. He drew the first map with *isothermals* (lines connecting points of the same temperature).

Friedrich Wilhelm Heinrich Alexander von Humboldt, usually called Alexander von Humboldt, was born in Berlin, into a noble family. He studied at Frankfurt-on-the-Oder, the University of Göttingen, and the Mining Academy in Freiberg. From 1792 to 1796, he worked in the Prussian mining service. There, he made improvements in mining technology, including the invention of a safety lamp. From 1799 to 1804, Humboldt traveled in Mexico, Central America, and South America. His careful observation of geology, climate, and biology of those areas established his scientific reputation. From 1804 to 1827, he lived mainly in Paris.

Humboldt spent most of his remaining years in Berlin, helping establish it as a scientific center. In 1829, he explored the Ural Mountains and Central Asia to report on mineral resources for the czar of Russia.

Humboldt was a major popularizer of science. His writings include the five-volume work *Cosmos* (1845-1862), an enormously popular account of the physical universe. Rachel Laudan

See also Geology (The rock dispute).

Humboldt Current. See Peru Current.

Hume, David (1711–1776), a Scottish philosopher, was one of the most important figures in the history of philosophy. His thought marks the culmination of the British philosophical movement of the 1700's known as *empiricism.* The empiricists tried to show that all human thought and knowledge is based on the direct experience of the world through the senses. In order to show this, Hume and the other empiricists had to analyze the workings of the human mind. See Empiricism.

Hume's thought. Hume distinguished between *impressions* and *ideas.* Impressions are made on the mind when we directly experience anything. Ideas do not arise directly from experience, but are formed from previous impressions. For example, one's idea of a table or of a triangle is based on previous impressions and experiences of those things. We can form ideas of things we have never experienced, but only by combining previous experiences in new ways.

Hume applied this theory to philosophical questions, especially questions about the limits of knowledge. He maintained that since ideas must be based on experience, ideas without such basis lack a proper foundation. Hume argued that a number of ideas central to traditional philosophy are problematic in this way. These include the ideas of substance, the self, and causality.

The *idea of substance* is the idea of the stuff or matter of a thing, as opposed to its qualities. These qualities (for example, color, shape, smell, or taste) are considered to be qualities *of* something—that is, of the substance or matter. But we can experience only the qualities, and we never can experience the substance itself. Thus, the idea of substance has no meaning.

The *idea of the self* is the idea of something in a person that remains identical through time. I have the idea that I remain the same person despite the changes that occur in me. But, since I cannot locate in myself an element that is always present and never changes, the idea of such a self has no basis in experience.

The *idea of causality* is the idea that two events are connected in such a way that one causes the other. For example, it seems that one billiard ball rolling into another causes the second ball to move. Hume pointed out that, in such cases, we perceive only that events like the cause are *regularly followed* by events like the effect. The rolling of one ball into another is regularly followed by the second ball starting to move. But we never observe anything that actually connects the two events. But causes are supposed to connect events. Thus, the idea of causality, like the ideas of substance and self, has no basis in experience.

Hume argued that there are only two kinds of things about which we can know anything: *matters of fact* and *relations of ideas.* Statements about matters of fact are really descriptions of our experience of the world and ourselves. Statements about relations of ideas concern the truths of logic and mathematics and the definitions of words and ideas. They are supposedly discoverable by the operations of reason alone without reliance on sense experience. For example, we need not take a survey of bachelors to know that bachelors must be unmarried and male. This truth is discoverable solely on examination of the ideas involved. According to Hume, any statement is worthless that neither makes clear the meanings of ideas nor tells us anything about experience. Hume believed there were many such statements in traditional philosophy and theology. His aim was to expose long-accepted but unsound ideas.

In ethics, Hume argued that it is impossible to conclude from how things and people *are* anything about how they *should* be. He also believed that our basic choices are determined, not by reason, but by desires and passions that use reason as a tool to attain their goals. In religion, Hume criticized the argument that the world resembles a large and complex *artifact*—that is, something made by design and intention. Thus, it seems natural to conclude that it must have been made by a being capable of such a grand achievement, who could only be God. But Hume objected that it could have come into existence without any conscious plan or effort on the part of a God.

Hume's life. Hume was born and educated in Edinburgh. His first major work was *A Treatise of Human Nature* (1739). His other works include *An Enquiry Concerning Human Understanding* (1748), *An Enquiry Concerning the Principles of Morals* (1751), *Dialogues Concerning Natural Religion* (1779), an influential history of Britain, and many essays. Ivan Soll

See also Philosophy (Modern philosophy [Empiricism]).

Humidifier, *hyoo MIHD uh FY uhr,* is a device that increases the amount of moisture in indoor air or a stream of air. It operates by allowing water to evaporate from a pan or a wetted surface, or by circulating air through an air-washer compartment that contains moisture.

Humidifiers are used in industry to create an atmosphere suitable for testing or processing certain materi-

als. In homes, humidifiers help reduce static electricity and prevent wood structures and furniture from becoming brittle. Many people use humidifiers in the winter to help them feel more comfortable. Heated air is very dry and can irritate nasal passages. Humidifiers help reduce such irritation. They also slow the evaporation of moisture from people's skin. The cooling effect of evaporation is thereby reduced, making people feel warmer at lower temperatures. Evan Powell

See also **Air conditioning** (Controlling the moisture); **Dehumidifier; Humidity.**

Humidity is a term that describes the amount of water vapor in the air. The humidity varies according to the temperature and pressure of the air. The warmer the air is, the more water vapor it can hold. When the air contains as much water vapor as it can hold at a certain temperature and pressure, the air is *saturated.*

The amount of water vapor in the air compared to the amount the air can hold at saturation is called *relative humidity.* If the air contains only half of the water vapor it can hold, the relative humidity is 50 percent. In clouds and fog, the air is saturated and the relative humidity is 100 percent. The lower air over oceans is almost saturated and the relative humidity is close to 100 percent. In the Sahara and other subtropical deserts, the relative humidity may be as low as 10 percent.

The relative humidity of an area may vary greatly during the day, even though the amount of water vapor in the air remains the same. In such cases, the relative humidity changes as the temperature rises and falls. The relative humidity may be high in the morning, when the temperature is low and the air cannot hold much more than its present water vapor. But as the temperature rises during the day, the air can hold more water vapor and the relative humidity becomes lower.

As air at a fixed pressure and with a constant amount of water vapor is cooled, it will reach a temperature where it becomes saturated. This temperature is called the *dew point.* If the temperature is lowered further, water vapor will begin to condense and form clouds, fog, or dew. The closer the temperature of the air is to its dew point, the higher the relative humidity will be.

Humidity affects our comfort and health. When the temperature and the relative humidity are high, most people feel uncomfortable and "sticky" because their perspiration does not evaporate easily. Many people use air conditioners and dehumidifiers in the summer to take water vapor out of the air. In winter, the heated air in buildings is dry and the relative humidity indoors may be very low. These conditions can cause drying of nasal passages and other health problems. As a result, people often use humidifiers in winter to put water vapor into the air. Alexis B. Long

Related articles in *World Book* include:

Air conditioning	Evaporation	Hygrometer
Cloud	Fog	Rain
Dehumidifier	Heat index	Weather
Dew	Humidifier	

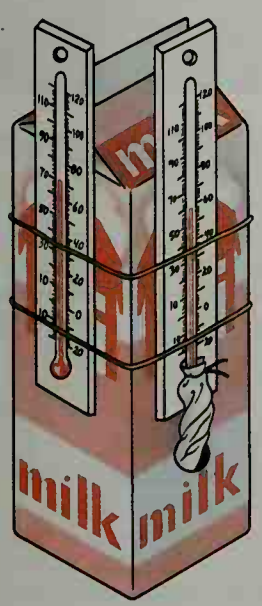
Hummingbird is a family of birds that contains the smallest bird in the world. Hummingbirds live only in the Western Hemisphere. More than 300 species are known. Only 19 varieties live in the United States, and all but one of these are found in the western and southwestern states. Hummingbirds get their names from the humming sound made by their wings, which move 60 to 70 times a second in the smallest species.

Size. The smallest of the hummingbirds is the *bee hummingbird,* which is a native of Cuba. The bee hummingbird is about 2 inches (5 centimeters) long, including the bill. The smallest hummingbird in the United States is the *calliope hummingbird,* which is native to the Western mountain regions. The calliope humming-

To make a hygrometer, cut a hole about 2½ inches from the bottom of an empty milk carton and fill the carton with water up to the opening. Fasten two thermometers to the carton, one with the bulb just above the hole. Wrap cloth around this bulb and push it through the hole into the water.

To determine relative humidity, allow the hygrometer to stand for 15 minutes in a breeze away from direct sunlight. Read both thermometers and use the temperatures to find the humidity on the chart, *below.* Read across from the wet-bulb readings. Read downward from the dry-bulb readings. For example, if the dry-bulb thermometer reads 70 °F and the wet-bulb thermometer reads 60 °F, the relative humidity is 55 percent.

WORLD BOOK illustration by Sarah Woodward



DRY-BULB TEMPERATURES °F.

WET-BULB TEMPERATURES °F.	56	58	60	62	64	66	68	70	71	72	73	74	75	76	77	78	79	80	82	84	86	88
38	7	2																				
40	15	11	7																			
42	25	19	14	9	7																	
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54	88	78	68	59	51	44	38	33	30	28	25	23	21	19	17	16	14	12	10	7	5	3
56		89	79	68	60	53	46	40	37	34	32	29	27	25	23	21	19	18	14	12	9	7
58			89	79	70	61	54	48	45	42	39	36	34	31	29	27	25	23	20	16	14	11
60				90	79	71	62	55	52	49	46	43	40	38	35	33	31	29	25	21	18	15
62					90	80	71	64	60	57	53	50	47	44	42	39	37	35	30	26	23	20
64						90	80	72	68	65	61	58	54	51	48	46	43	41	36	32	28	25
66							90	81	77	73	69	65	62	59	56	53	50	47	42	37	33	30
68								90	86	82	78	74	70	66	63	60	57	54	48	43	39	35
70									95	91	86	82	78	74	71	67	64	61	55	49	44	40
72											95	91	86	82	79	75	71	68	61	56	50	46
74													96	91	87	83	79	75	69	62	57	51
76															96	91	87	83	76	69	63	57
78																	96	91	84	76	70	64
80																			92	84	77	70
82																				92	84	77
84																					92	85
86																						92

Giant hummingbird
Patagona gigas
Found in the Andes, from Ecuador to Chile
8 ¼ inches (21 centimeters) long

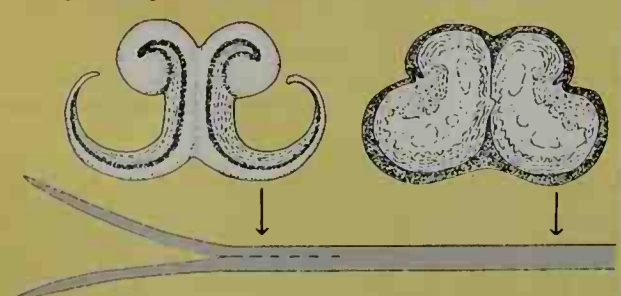
Bee hummingbird
Calypte helenae
Found in Cuba
2 inches (5 centimeters) long

WORLD BOOK illustration by Walter Linsenmaier

Bob Smith

The rufous hummingbird covers the outside of its nest with lichens and holds the structure together with cobwebs.

The end of the hummingbird's tongue is forked. The edges of the two parts curl together and form a double trough through which nectar is taken into the mouth.

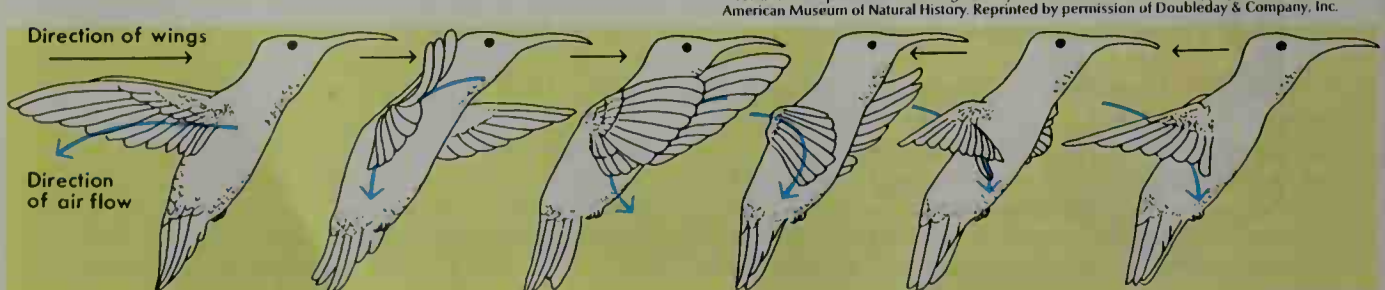


WORLD BOOK diagram adapted from "The Tongue Apparatus in Hummingbirds" by R. D. Weymouth in *ACTA Anatomica*, Vol. 58 (Karger, 1964).

How a hummingbird hovers

The diagram below shows how a hummingbird's wings move when the bird hovers in the air. The pictures represent one wingbeat. A hummingbird can beat its wings as fast as 70 times a second.

Illustrations adapted from *Hummingbirds* by Crawford H. Greenewalt. Copyright © 1960 by The American Museum of Natural History. Reprinted by permission of Doubleday & Company, Inc.



bird measures about 3 inches (8 centimeters) long.

Only a few hummingbirds are more than 6 inches (15 centimeters) long. The largest is the *giant hummingbird,* a native of the Andes Mountains of South America. It is about 8 $\frac{1}{4}$ inches (21 centimeters) long.

Habits. Some members of the hummingbird family are among the most brightly colored birds in the world. They have glittering patches of emerald-green, deep violet, fiery red, and glowing orange. They fly quickly and can dart upward, downward, backward, or forward with remarkable speed. Their long, slender bills are especially suited for sucking nectar from flowers, even the deep-throated or trumpet-shaped flowers, such as the honeysuckle and trumpet flower. The tongue of the hummingbird is also a useful tool for obtaining food from places difficult to reach. The end of the tongue is forked, and the edges of the two parts curl together to form a double trough through which the bird laps flower nectar into its mouth.

Food. Insects form an important part of the hummingbird's diet. The bird often finds insects inside the flowers, or seizes them while it hovers. Sometimes it steals insects from spider webs. The hummingbird uses threads from the web to build its cottony nest.

The ruby-throated hummingbird, one of the smallest and daintiest birds, grows less than 4 inches (10 centimeters) long. It is the only U.S. hummingbird commonly found east of the Mississippi River and north of Florida. Both male and female have a coat of metallic-green feathers on the upper parts of their bodies. The male has a bright red throat. The female's throat is white.

The female ruby-throated hummingbird prefers a position high in the branches of a tree. There she builds her tiny nest of shreds of bark, soft grass, and bits of plant or cattail fluff. Often, she covers the outside with lichens or bits of bark to camouflage the nest. During the nesting season, the male becomes very bold. He will fight off enemies much larger than himself. The mother bird usually lays two tiny white eggs about the size of navy beans. The young hatch in about two weeks. They have no feathers when they are born, and they cannot see. But within three weeks, they are fully feathered and strong enough to leave the nest. Donald F. Bruning

Scientific classification. Hummingbirds make up the family Trochilidae. The ruby-throated hummingbird is *Archilochus colubris.* The giant hummingbird is *Patagona gigas;* the bee hummingbird, *Calypte helenae;* and the calliope, *Stellula calliope.*

Humor. See Blood (History of blood research).

Humor. No one knows exactly why we laugh or why anything that is funny should cause us to make such a peculiar noise. It would be just as logical to stick our thumbs in our ears and wiggle our fingers as it is to giggle or bellow or howl with laughter. But when something strikes our "funny bone," our diaphragm flutters up and down, and we laugh.

The urge to laugh appears very early. Babies smile, then coo, and finally chuckle when pleased. If certain parts of the baby's body are tickled with the fingers, laughter occurs. But by the time children attend school, they also laugh at things they hear and see.

Stories are among the most popular forms of humor. As a rule, a story is considered inferior if it embarrasses someone, if it makes something sacred appear common, if it makes a person's weakness the cause for laughter, if it has to have vulgarity to be funny, or if everyone cannot join in the enjoyment of the joke.

The humor of situation

If a man meets a lady on the street, tips his hat to her, and a pigeon flies out from beneath it, most of the people who see it would roar with laughter. This is called the humor of the *unexpected happening.*

Another kind of situation humor is the *incongruous* (putting together unrelated things). Boys and girls see dogs every day and think nothing of them. But if a dog enters a classroom, everyone laughs. The dog does not belong there, and the situation is incongruous.

The humor of words

Situation humor need not be described in words. By far the greatest amount of humor is told rather than seen. Certain words are funny in their very sounds, like *bobble* and *squirt.* Sometimes people get mixed up in pronouncing their words, and instead of saying "people think" they might say "thinkle peep."

Puns, or double meanings, furnish us with much of our humor. Puns are *plays on words,* in which one word is said when another one is meant. For example, it is said that Ben Jonson was asked by a friend to make a pun. Ben replied, "Pun what subject?" for "Upon what subject?" The friend laughed at this pun, but said, "Oh, the king." Ben then said, "But the king is not a subject. He is the king."

Hyperbole is simply exaggeration. Sometimes it includes a twisting or distortion of the truth for the sake of humor. Common expressions of everyday life are often hyperboles. If a woman says "It's raining cats and dogs" she is using hyperbole. And if she is answered with "I know. I just stepped in a poodle," she hears a pun.

Repetition is also a popular way of gaining laughter, but it does not produce a very high grade of humor. In many of the jokes told, a thing happens twice in exactly the same way. But the third time it happens differently, and the point of the story is revealed.

A man's car stuck in the mud one rainy day. He walked to the nearest farmhouse to telephone for help. The farmer had no telephone, but said the farm down the road had one. Muttering angrily, the man plodded on through the rain. The second farmer's telephone was out of order, but this farmer said another farm still farther down the road had one. The motorist was near the exploding point when he reached the third farm. As the farmer shuffled to the door, the motorist yelled, "You idiot! I wouldn't use your phone even if you had one!"

Comparison and contrast often give rise to humor. They are almost the same as the incongruous situation. "My head's as clear as a bell. In fact, I hear it ringing" shows comparison. Contrast is illustrated in such expressions as "not enough sense to varnish a walnut."

The types of humor

Humor of words takes many forms. It can be gentle and kindly, or it can be harsh and biting. There is no exact distinction between these various types of humor.

Wit differs from most humor in being purely intellectual, rather than relying on incongruities that come up naturally. Most humor produces a smile, but wit usually

causes people to break out in sudden laughter.

Satire presents the weaknesses of humanity and makes fun of them. Usually, satire attempts to cure the foolishness by making people laugh at it.

Sarcasm is much more brutal than satire. It often takes the form of a biting speech. If one woman says to another woman, "That's a lovely dress, dear. Too bad they didn't have your size," the woman is sarcastic.

Irony implies the opposite of what is apparently being stated. Irony may begin as a compliment or a simple statement, but it conceals a sting in the remark. It is usually expressed by a tone of voice, and is often an understatement. A sign on freshly seeded grass may say only "Please," but probably means, "Have enough sense to stay on the sidewalk, where you belong!"

Farce, slapstick, and buffoonery involve such pranks as throwing custard pies or pushing unsuspecting persons into swimming pools.

Parody and burlesque change the wording of a well-known story or song to produce comic results.

Mimicry imitates another person's habits, gestures, or speech for comic effect. Sarah Blacher Cohen

Related articles in *World Book* include:

American humorists

Ade, George	Marquis, Don	Rogers, Will
Billings, Josh	Nasby, Petroleum	Stockton, Frank R.
Day, Clarence	Vesuvius	Thurber, James
Dunne, Finley P.	Nash, Ogden	Twain, Mark
Lardner, Ring	Perelman, S. J.	Ward, Artemus

Other humorists

Beaumarchais, Pierre de	Shaw, George Bernard
Leacock, Stephen B.	Swift, Jonathan
Munro, Hector H.	Wilde, Oscar
Rabelais, François	Wodehouse, P. G.

Other related articles

Black humor	Irony	Pun
Burlesque	Musical comedy	Satire
Comedy	Parody	

Humpback. See Hunchback.

Humpback whale is a baleen whale that lives in all the oceans. The humpback whale can reach a length of 62 feet (19 meters). It has a tapered head and enormously long, thin flippers. The skin is usually white underneath and dark gray or black on the back and sides. The humpback whale has a fin on the back just behind the middle of the body. This fin often has a ridge or "hump," giving the whale its name.

The humpback whale has 270 to 400 thin, fringed plates, called *baleen,* on each side of the upper jaw. The whale feeds by opening its mouth wide and lunging through schools of small fish or masses of shrimplike animals called *krill.* It filters the prey by squeezing the water out of its mouth through the baleen.

Humpback whales usually travel in groups. They are highly acrobatic, sometimes jumping clear of the water. Each year humpback whales migrate, often close to shore, from polar waters to tropical waters, where they breed. Humpback whales communicate with a complex variety of moans and screams. At the breeding grounds, males repeat certain sounds for long periods of time. These "songs" can sound hauntingly beautiful.

The humpback whale is an endangered species. In the early 1990's, only about 25,000 of them remained.

Scientific classification. The humpback whale belongs to the suborder Mysticeti, order Cetacea. Its scientific name is *Megaptera novaeangliae.* Bernd Würsig

Humperdinck, *HOOM puhr DIHNGK,* **Engelbert** (1854-1921), was a German composer. He composed mainly vocal works, and his music shows the influence of the German folk song. Humperdinck gained immediate success for his children's opera *Hansel and Gretel* (1893), his best-known composition. He wrote the music for a text his sister adapted from a Grimm's fairy tale. His other important work is the opera *The Royal Children* (1910), which also had a fairy-tale theme. Humperdinck wrote a number of choral works and more than 60 songs. He also wrote incidental music for plays, including four plays by William Shakespeare.

In 1880, Humperdinck met the German composer Richard Wagner. He served as Wagner's assistant and helped him score and prepare for the first performance of the opera *Parsifal* (1882). During his career, Humperdinck also taught music in a number of conservatories. He was born in Sieburg, near Bonn. Charles H. Webb

Humphrey, Hubert Horatio (1911-1978), served as Vice President of the United States under President Lyndon B. Johnson, and was the Democratic presidential nominee in 1968. Humphrey lost to former Vice President Richard M. Nixon. Before his election as Vice President in 1964, Humphrey had been elected to the U.S. Senate three times. He was the first Democrat ever elected to the Senate from Minnesota. In 1970, he was again elected to the Senate, and he was reelected in 1976. In 1977, the Senate made Humphrey the deputy president pro tempore of the Senate, a new post. The title will be given to all former Presidents and Vice Presidents who later become members of the Senate.

Early life. Humphrey was born on May 27, 1911, in Wallace, South Dakota. He graduated from the Denver College of Pharmacy in 1933, and worked for four years in his father's drugstore. He later returned to college, and graduated from the University of Minnesota in 1939. Humphrey earned a master's degree at Louisiana State University. He then worked for the federal Work Projects Administration, and for the War Manpower Commission in Minneapolis. He also taught political science at Macalester College in St. Paul, Minnesota.

In 1936, Humphrey married Muriel Fay Buck (1912-1998). They had four children, Nancy Faye (1939-), Hubert Horatio III (1942-), Robert Andrew (1944-), and Douglas Sannes (1948-).

Humphrey entered politics in 1943, when he ran unsuccessfully for mayor of Minneapolis. In 1944, he helped merge Minnesota's Democratic and Farmer-Labor parties into the Democratic-Farmer-Labor Party. Humphrey was elected mayor of Minneapolis in 1945 and was reelected in 1947. He gained national fame at the Democratic National Convention in 1948, when he successfully led the fight for a strong party stand on civil rights.

Harris and Ewing

Hubert H. Humphrey

Senator and Vice President. Humphrey was elected to the U.S. Senate in 1948, and was reelected in 1954 and 1960. In 1961, he became Senate Democratic *whip* (assistant leader). In the Senate, he was a leading spokesman for arms control, civil rights, medical aid to the needy, and aid to education. Humphrey suggested creation of the federal Food for Peace program, which makes U.S. farm products available to poor countries and needy people. He was also the first to prominently promote the establishment of a peace corps, an overseas volunteer work program. Humphrey campaigned for the presidential nomination in 1960, but withdrew after losing two primary elections to Senator John F. Kennedy of Massachusetts.

In the 1964 presidential election, President Johnson and Humphrey defeated their Republican opponents, Senator Barry M. Goldwater of Arizona and Representative William E. Miller of New York. Humphrey became one of the busiest Vice Presidents in United States history, serving as chairman of several government councils.

Presidential candidate. In 1968, the Democratic National Convention nominated Humphrey for President. He and his running mate, Senator Edmund S. Muskie of Maine, lost to their Republican opponents, Nixon and Governor Spiro T. Agnew of Maryland. For the electoral vote, see **Electoral College** (table). Humphrey campaigned for, but did not win, the 1972 Democratic presidential nomination. Finlay Lewis

See also **Johnson, Lyndon B.; Muskie, Edmund S.; Nixon, Richard M.; Vice President of the United States** (Growth of the vice presidency).

Humus, *HYOO muhs,* is a dark brown substance found in soil. It is formed when roots, plants, and the dead bodies of small animals decay. The decay is caused by the action of microscopic living beings called *bacteria* and *fungi.* The amount of humus in soil affects the soil's texture and its ability to hold moisture and to supply necessary food. A good mixture of humus generally increases the yield and quality of a crop.

Humus is soft and spongy. It fills the spaces between the mineral grains of the soil, and enables the plant roots to send out tiny hairs through which they absorb water and food. Humus also holds water and reduces the problem of water running off and *eroding* (wearing away) the soil. Taylor J. Johnston

Hun was a member of the wandering and warlike people that invaded the Roman Empire in the A.D. 400's. Under Attila, their greatest leader, the Huns nearly destroyed the Roman empires of the east and west.

The Huns moved westward across the Volga River about A.D. 350 and defeated the Alani people. Then they conquered and drove out the Goths. With their subject peoples, the Huns invaded Gaul (now mainly France) under Attila. They were finally halted in 451, and they later failed in another attempt at invasion. After the death of Attila (453), the subject peoples revolted and defeated the Huns. The Huns were later absorbed into the various peoples of Europe. William G. Sinnigen

See also **Attila; Goths.**

Hunchback is a nonmedical term for the forward bending of the spine. Doctors use the term *kyphosis* to describe this condition. A severe case of kyphosis results in a rounded or sharp prominence of the upper part of the back. Because this part of the back sticks out like a big hump, the condition is sometimes called *humpback.* Kyphosis is caused by any condition that deforms the bones of the upper part of the spine so that the person is bent forward. Diseases that cause kyphosis include tuberculosis, syphilis, and rheumatoid arthritis. Fractured spinal bones also may cause a hump in the back. Madison B. Cole, Jr.

Hundred Years' War (1337-1453) extended over the reigns of five English and five French kings who fought for control of France. This struggle between England and France actually consisted of a succession of wars broken by truces and treaties. The war had several contributing causes. Efforts of the French kings to control the English-held province of Guyenne in southwest France angered the English. The French supported the Scots against England, and the French attempted to control Flanders and the English wool trade there. English and French sailors and fishermen quarreled over rights in the English Channel.

The war began in 1337. That year, King Philip VI of France declared he would take over Guyenne, and King Edward III of England, whose mother was the sister of three French kings, claimed the French throne.

In the fighting that followed, the English won most of the battles. But the French won the war. English resources were about a third as great as those of the French. Several events hindered the course of the war. These events included peasant rebellions; pillaging in France by unemployed soldiers; the *Black Death,* a form of plague, in the two countries; and a peasants' revolt in England in 1381. The war weakened the powers of the nobility and strengthened centralized government in both countries. The war also marked the decline of feudalism, the rise of French unity, the development of new military tactics, and the growth of English sea power.

English archers and infantry won the war's greatest victory in the Battle of Crécy (1346). The English also won the Battle of Poitiers (1356). The Treaty of Brétigny in 1360 began a brief period of peace. But Henry V of England renewed the fighting and emerged triumphant at the Battle of Agincourt (1415). The Treaty of Troyes in 1420 made Henry V heir to the French crown.

After Henry V died in 1422, the French disputed the English claim to the throne, and war flared. By 1428, the English had swept through northern France and laid siege to Orléans. Joan of Arc led a French army and ended the siege in 1429. She became a prisoner of the English, who later burned her to death. The French continued to win battles. By 1453, England had lost all its territory on the continent of Europe, except Calais. The French took Calais in 1558. C.T. Allmand

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Heroes' Square in Budapest commemorates Hungary's history. The tall column has a statue of the angel Gabriel at the top and, at its base, statues of chiefs of the Magyar tribes that settled in the region in the 800's.

Hungary

Hungary is a small, landlocked country in central Europe. Budapest is its capital and largest city and the center of its culture and industry.

Most of eastern Hungary is nearly flat, but the western part has hills and low mountains. The country's chief natural resources include fertile soil and a favorable climate for farming.

Great economic and social changes occurred in Hungary in the last half of the 1900's. Before World War II (1939-1945), most of the country's income came from agriculture, and the majority of Hungarians lived in rural areas and worked on farms. But in the mid-1900's, Hungary's economy began to become industrialized. Today, manufacturing and other industries contribute more to the national income than does farming. More Hungarians work in industry than on farms.

As Hungary became more industrialized, modern city ways of life became popular. Many of the country's old rural customs disappeared. But Hungarians still love the highly seasoned foods, excellent wines, and lively folk music for which they have long been famous.

Hungary was a large, independent, and powerful kingdom until the late 1400's. From the early 1500's to the late 1600's, the Ottoman Empire ruled much of the country. Hungary then became part of a huge empire ruled by the Austrian branch of the Habsburgs, a powerful European *dynasty* (line of rulers). The empire of the Habsburgs collapsed after World War I ended in 1918. Hungary then lost about two-thirds of its land but regained its independence.

In the late 1940's, Hungarian Communists gained control of the country's government. They began to restrict the freedom of the people and to control the entire economy. In 1956, the Hungarian people revolted against their Communist government and Soviet domination. Soviet troops quickly crushed the revolution. But opposition to Communist control continued.

In the late 1980's, the Soviet Union made reforms toward giving its people more freedom. The reform movement in Hungary then gained strength. The power and authority of the Communist Party in Hungary began to erode. Public pressure forced the party's leaders to allow other political parties to form. In 1989, the Communist Party ended its monopoly on Hungary's government, and it allowed more freedom. Non-Communist parties were officially legalized. In 1990, Hungary held its first multiparty elections since 1949.

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Facts in brief

Capital: Budapest.
Official language: Magyar (Hungarian).
Official name: Magyar Köztársaság (Republic of Hungary).
Area: 35,920 mi² (93,032 km²). *Greatest distances*—east-west, 312 mi (502 km); north-south, 193 mi (311 km).
Elevation: *Highest*—Mount Kékes, 3,330 ft (1,015 m) above sea level. *Lowest*—near Szeged, 259 ft (79 m) above sea level.
Population: *Estimated 2002 population*—9,956,000; density, 277 per mi² (107 per km²); distribution, 64 percent urban, 36 percent rural. *1990 census*—10,374,823.
Chief products: *Agriculture*—chickens and eggs, corn, grapes, hogs, milk, potatoes, sugar beets, wheat. *Manufacturing*—buses and railroad equipment, electrical and electronic goods, food products, medical and scientific equipment, pharmaceuticals, steel, textiles. *Mining*—bauxite.
Money: *Basic unit*—forint. One hundred filler equal one forint.

Government

National government. Hungary has a one-house parliament, called the National Assembly. Voters elect the parliament's members to four-year terms. The Assembly formally enacts all laws.

The president is the head of state and the country's most powerful government official. The National Assembly elects the president to a five-year term. The president's duties include acting as commander in chief of the armed forces, authorizing elections, and serving as the parliament between Assembly sessions.

The Assembly appoints a Council of Ministers. Members of this group head the various government departments. The chairman of the council serves as Hungary's head of government, or prime minister.

Local government. Hungary is divided into 19 counties and 6 cities, including Budapest, that rank as counties. A council governs each county or city of county rank, as well as each town and rural community. Council members are elected by the people to four-year terms.

Politics. Hungary's main political parties include the Alliance of Free Democrats, the Federation of Young Democrats-Hungarian Civic Party, the Hungarian Socialist Party, and the Independent Smallholders' and Peasants' Party. The Alliance is a moderately liberal party, and the Federation is moderately conservative. The Socialists support continued economic reform to increase private ownership of farms and businesses and to develop a market economy. They also support a closer association with the rest of Europe. The Smallholders' Party is a conservative party. It favors policies that benefit farmers. Its main support is in rural and agricultural areas, especially in eastern Hungary. Other parties include the Christian Democratic People's Party and the Hungarian Democratic Forum, both conservative parties, and the Hungarian Workers' Party, which is a Communist party.

Courts. The Supreme Court is Hungary's highest court. Other courts include county, district, labor affairs, and military courts.

Armed forces. About 45,000 people serve in Hungary's army and air force. A number of men also serve in the country's internal security force. Men may be drafted for any of these services at age 18. Draftees serve in the armed forces for 9 months.

People

Ancestry. Most of the people of Hungary are Magyars. Magyars are descendants of the Magyar tribes that migrated to Hungary from the east in the late 800's. The people of these tribes became the first Hungarians. Their language developed into the language now spoken in Hungary. Today, Magyars also include people of other ethnic backgrounds who have adopted the Hungarian language and Hungarian customs. These people, in turn, have contributed to Hungarian culture. The country's other ethnic groups include Croats, Germans, Gypsies, Romanians, Serbs, and Slovaks.

Language. Magyar (also called Hungarian) is Hungary's official language and is spoken throughout the country. But members of minority groups use their own language among themselves. In parts of Hungary, the people speak various *dialects* (local forms) of Magyar. Magyar is a *Uralic-Altaic* language that is related to Es-

Alexander M. Chabe

The Hungarian House of Parliament overlooks the Danube River in Budapest. The impressive building is the meeting place of the National Assembly, Hungary's parliament. It also houses a public library and various art treasures.

Symbols of Hungary. Hungary's flag has horizontal stripes of red, white, and green, the traditional national colors. It was adopted in 1957. The coat of arms also includes the national colors. It was adopted in 1990.

WORLD BOOK map

Hungary is a landlocked country in central Europe. It is surrounded by seven other countries.

WORLD BOOK map

Counties*

Bács-Kiskun	541,000	D	4
Baranya	412,000	D	3
Békés	405,000	D	5
Borsod-Abaúj-Zemplén	750,000	B	5
Csongrád	428,000	D	5
Fejér	426,000	C	3
Győr-Moson-Sopron	426,000	B	2
Hajdú-Bihar	550,000	C	6
Heves	330,000	B	5
Jász-Nagykun-Szolnok	423,000	C	5
Komárom-Esztergom	313,000	B	3
Nógrád	224,000	B	4
Pest	972,000	C	4
Somogy	338,000	D	2
Szabolcs-Szatmár-Bereg	573,000	B	6
Tolna	250,000	D	3
Vas	272,000	B	1
Veszprém	379,000	C	2
Zala	303,000	C	1

Cities and towns

Abony*	14,618	C	5
Ajka	33,131	C	2
Baja	39,372	D	4
Balassagyarmat	18,228	B	4
Balatonfüred	13,926	C	2
Balmazújváros*	17,971	B	6
Bátonyterenye*	15,193	B	4
Békés*	21,739	D	6
Békéscsaba	67,475	D	6
Berettyóújfalu	16,569	C	6
Bonyhád	15,110	D	3
Budaörs*	21,196	C	4
Budapest	1,995,696	C	4
Cegléd	36,719	C	4
Celldömölk	11,851	C	2
Csongrád	19,354	D	5
Csorna	10,652	B	2
Dabas*	14,563	B	3
Debrecen	217,706	B	6
Dombóvár	21,024	D	3
Dunakeszi	27,765	B	4
Dunaújváros	58,294	C	3
Eger	63,794	B	5
Érd	45,408	C	3
Esztergom	29,833	B	3
Gödöllő	29,295	B	4
Gyoma	15,830	C	5
Gyöngyös	35,734	B	4
Győr	130,941	B	2
Gyula	34,783	D	6
Hajdúböszörmény	31,079	B	6
Hajdúnánás	18,621	B	6
Hajdúszoboszló	23,815	C	6
Hatvan	23,998	B	4
Hódmezővásárhely	50,745	D	5
Jászberény	28,742	C	4
Kalocsa	18,209	D	4
Kaposvár	70,728	D	2
Kapuvár	10,813	B	2
Karcag	22,489	C	5
Kazincbarcika	35,799	A	5
Kecskemét	105,559	C	4
Keszthely	22,263	D	2
Kiskörös	14,763	D	4
Kiskunfélegyháza	33,834	D	4
Kiskunhalas	29,878	D	4
Kisújszállás	13,700	C	5
Kisvárda	13,008	A	7
Komárom	18,051	B	3
Komló*	28,580	E	3
Körmend	12,528	C	1
Köszeg	12,137	C	1
Makó	26,424	D	5
Marcali	12,630	D	2
Mátészalka	18,711	B	7
Mezőkövesd	17,768	B	5
Mezötúr	19,863	C	5
Miskolc	189,655	B	5
Mohács	19,970	E	3
Monor	18,516	C	4
Mosonmagyaróvár	29,977	B	2
Nagyatád	13,505	D	2
Nagykanizsa	53,060	D	2
Nagykörös	26,737	C	4
Nyírbátor	13,338	B	7
Nyíregyháza	115,643	B	6
Orosháza	33,789	D	5
Oroszlány*	21,192	C	3
Ózd	41,868	A	5
Paks	21,022	D	3
Pápa	33,859	C	2
Pécs	172,177	E	3
Püspökladány	15,986	C	6
Salgótarján	46,414	B	4
Sárospatak	15,119	A	6
Sárvár	15,626	C	1
Sátoraljaújhely	18,467	A	6
Siklós	10,602	E	3
Siófok	22,606	C	3
Sopron	56,324	B	1
Szarvas	18,393	C	5
Százhalombatta*	16,783	C	3
Szeged	178,878	D	5
Székesfehérvár	109,666	C	3
Szekszárd	37,406	D	3
Szentendre*	20,651	B	4
Szentes	32,086	D	5
Szigetszentmiklós*	20,011	C	4
Szigetvár	11,355	E	2
Szolnok	80,859	C	5
Szombathely	85,932	C	1
Tapolca	18,176	C	2
Tata	24,392	B	3
Tatabánya	73,505	B	3
Tiszafüred	13,994	B	5
Tiszaújváros	17,985	B	6
Törökszentmiklós	23,457	C	5
Vác	34,283	B	4
Várpalota	26,361	C	3
Veszprém	65,789	C	2
Zalaegerszeg	62,908	C	1

*County names and names of cities marked with an asterisk do not appear on map; key shows general location.
Source: 1994 official estimates for cities and towns; 1995 official estimates for counties

© David Ball, Corbis Stock Market

Shoppers stroll along Vaci Utca, a popular pedestrian-only street in Budapest known for its fashionable stores. A majority of Hungary's people live in urban areas.

tonian and Finnish. For information on the *Uralic-Altaic* languages, see **Language** (Language families).

Way of life

Housing. Most rural families in Hungary live in small houses. Many of these houses have *stucco* (rough plaster) outer walls and a tile roof. City dwellers live in apartments or one-family homes.

A housing shortage exists in most Hungarian cities. The shortage began to develop in the mid-1900's because of the rapid shift of population from the rural areas to the urban areas. Many people left the farms to seek industrial jobs in the cities.

Clothing. Most of the people of Hungary, especially city dwellers, dress much as people do in Western Europe and North America. Many rural Hungarians once wore colorfully embroidered costumes as everyday clothing. But today, these people wear such costumes only on special occasions.

Food and drink. Hungarians enjoy soup with their meals. The most famous Hungarian soup is a thick soup, or stew, called *goulash.* It consists of cubes of beef or other meat, gravy, onions, and potatoes. Other ingredients may also be added to the goulash, which is highly flavored with a seasoning called *paprika.* Hungarians use paprika in many of their dishes.

Hungarians eat more pork than any other kind of meat, but they also enjoy beef and poultry. Noodles, potatoes, and small dumplings are popular side dishes. Hungary is famous for its pastries. One of the most popular pastries is *rétes,* or *strudel.* It consists of a thin, flaky crust filled with fruit or cheese. The country is also famous for its many excellent wines.

Recreation. Many Hungarians enjoy visiting coffee houses. There, they read or chat with friends over a cup of coffee or a glass of wine or beer. Hungarians also enjoy art exhibits and the theater. Going to concerts and operas is a popular pastime. Hungarians are famous for their lively folk music.

Soccer is the most popular sport in Hungary. The country's other favorite sports include basketball, fencing, and volleyball. Many Hungarians also enjoy boating, fishing, and swimming. In addition, the country has many health resorts called *spas,* which offer medicinal bathing in mineral waters.

Religion. About two-thirds of Hungary's people are Roman Catholics. Nearly one-fourth of the population are Protestants. The Reformed (Calvinist) Church and the Lutheran Church are the largest Protestant groups. Other religious groups include Catholics of the Byzantine Rite, Jews, and Unitarians.

Education. Almost all adult Hungarians can read and write. For the country's literacy rate, see **Literacy** (table: Literacy rates).

Hungarian law requires children from 6 through 16 years of age to attend school. Hungary has eight years of primary school. Primary school graduates may then go on to a two-year vocational school, a three-year skilled worker training school, or a four-year high school.

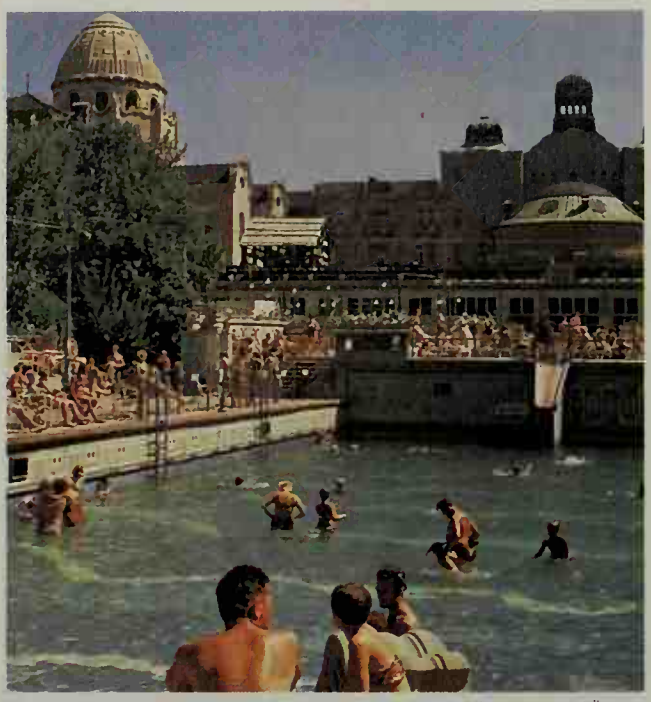
Hungary has two main kinds of high schools—*gymnasiums* and technical secondary schools. Gymnasiums, a traditional type of European high school, provide a general education. Technical secondary schools offer their students training in agricultural, commercial, or industrial skills in addition to providing a general education.

The Hungarian government operates most educational institutions. Nearly all primary and secondary school students attend free public schools. Religious groups operate some primary and secondary schools. These schools charge a fee.

Students who complete four years of high school may enter a school of higher learning. Hungary's many institutions of higher learning include five *academic* (general education) universities, five medical universities, and nine technical universities. The largest and most important universities are in Budapest.

© Red Dot

The main square in picturesque Szentendre has cobblestone streets, historic buildings, and museums. Many tourists and artists visit the town, which lies north of Budapest.



E. Henriksson from Carl Östman

Hungary's medicinal baths attract Hungarians and foreigners who believe the warm, mineral-filled waters have healthful qualities. This picture shows the famous Gellert Baths in Budapest.

The arts. Hungary's most outstanding contribution to the arts has been in music. The country has produced a number of world-famous composers. Franz Liszt was a prominent composer and pianist of the 1800's. The expressive and highly original works of Béla Bartók established him as one of the greatest composers of the 1900's. Bartok's compositions and those of his friend Zoltán Kodály were strongly influenced by Hungarian folk music.

Hungary has also produced many fine writers. But few of them are known outside the country. Hungarians highly regard the works of the poet Sándor Petofi and the novelist Mor Jókai, who wrote during the 1800's. The poets Endre Ady and Attila József rank among the most respected Hungarian writers of the 1900's. The most famous Hungarian author, Ferenc Molnár, wrote many plays, novels, and short stories in the early 1900's.

Hungarian writers have traditionally been concerned with political and social problems. In the 1950's, for example, some writers expressed in their works the people's discontent with the Communist government. These authors thus spoke for the Hungarian people, whose desire for a better life led them to rebel in 1956. After the unsuccessful revolution, the writers who had criticized the Communist government had to flee the country or were imprisoned. The government also clamped tight controls on literary and other artistic activities.

In the 1960's, the government began to relax its controls on cultural life to make its rule more acceptable to the people. In 1989, constitutional changes gave the people complete artistic freedom.

The land

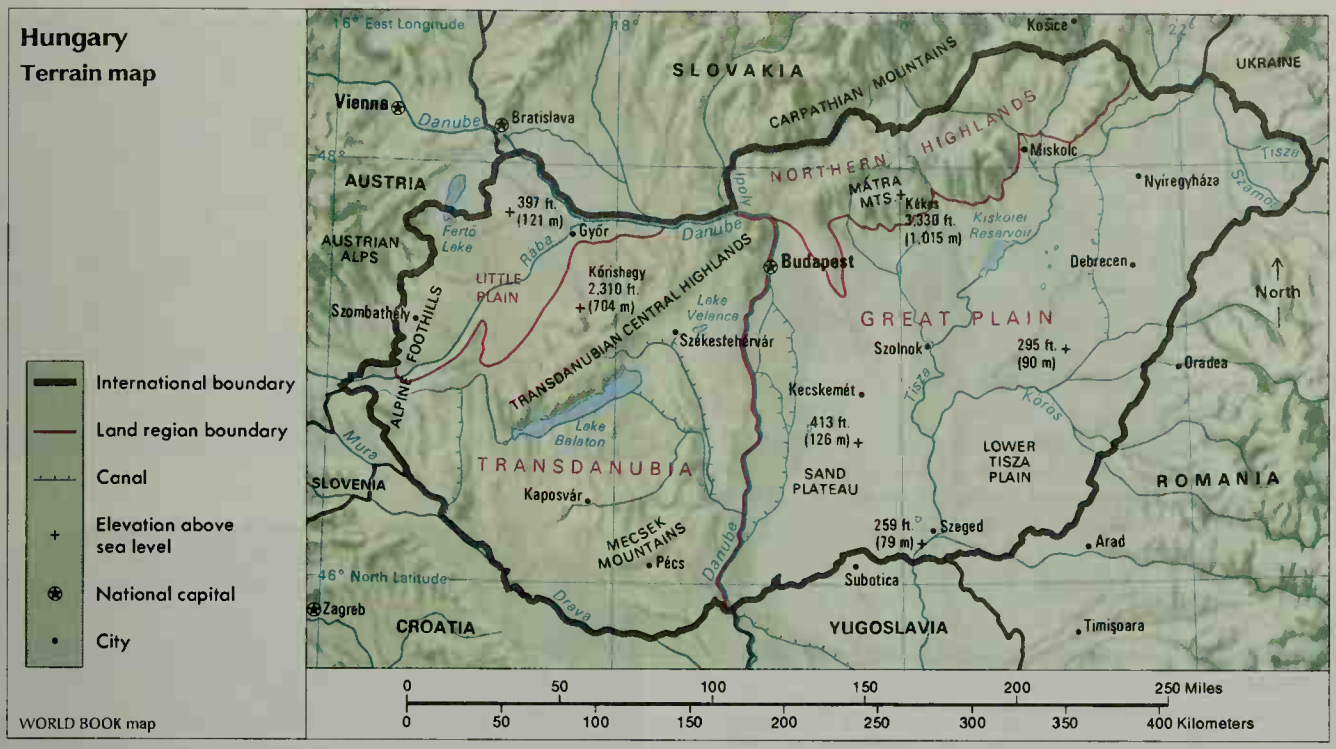
Most of Hungary's land is low. About two-thirds of the country lies less than 650 feet (198 meters) above sea level. All of eastern Hungary is nearly flat, except for low mountains in the north. Mount Kékes, Hungary's highest point, rises 3,330 feet (1,015 meters) above sea level in these mountains. Western Hungary consists mainly of rolling hills and low mountains.

Hungary has four main land regions: (1) the Great Plain, (2) Transdanubia, (3) the Little Plain, and (4) the Northern Highlands.

The Great Plain covers all of Hungary east of the Danube River, except for the mountains in the north. The region occupies about half the country's area. Its near-

© ZEFA from Leo de Wys

Hungary's Lake Balaton ranks as the largest lake in central Europe. It lies among the gently rolling hills and low mountains of Transdanubia, a land region in western Hungary. The lake and its scenic surroundings make the area one of the country's most popular recreation spots.



ly flat surface is broken only by river valleys, sand dunes, and small hills. The Great Plain is mostly agricultural. The far southeastern section has Hungary's richest soil.

Transdanubia covers all of Hungary west of the Danube, except for the northwest corner of the country. Transdanubia consists mostly of hills and mountains. A chain of low, rounded mountains called the Transdanubian Central Highlands stretches along the entire northern side of Lake Balaton. The chain extends to the bend of the Danube north of Budapest. Gently rolling hills lie south of Lake Balaton, and more low mountains lie still farther south. The foothills of the Austrian Alps rise in the west. The southeastern part of Transdanubia is a major farm region.

The Little Plain occupies the northwest corner of Hungary and is the smallest land region. It is flat except for the foothills of the Austrian Alps along the western boundary. Most of the area is good for farming.

The Northern Highlands rise northeast of the Danube River and north of the Great Plain. This mountainous region forms part of the great Carpathian mountain system of central Europe. Many of the mountain slopes are steep. Thick forests, small streams, and spectacular rock formations help make the Northern Highlands a region of scenic beauty. It is also an important manufacturing and mining area.

Rivers and lakes. The country's longest river is the Tisza, which flows 360 miles (579 kilometers) from northeast to south through eastern Hungary. The Tisza is a branch of Hungary's most important river, the Danube. The Danube flows through seven European countries, including Hungary. It forms part of Hungary's northern border, then flows from north to south through the central part of the country. The Danube serves as the chief shipping route for trade between Hungary and its neighbors as well as for trade within the country.

Lake Balaton in western Hungary is the largest lake in central Europe. It covers about 230 square miles (596 square kilometers) and is a popular recreation and vacation spot.

Climate

The climate varies little throughout Hungary because the country is small and has no great variety of natural features. In general, Hungary has cold winters and hot summers. January temperatures average about 29 °F (−2 °C), and July temperatures average about 70 °F (21 °C). The country receives an average of about 24 inches (60 centimeters) of *precipitation* (rain, snow, and other forms of moisture) each year. May, June, and July are Hungary's wettest months.

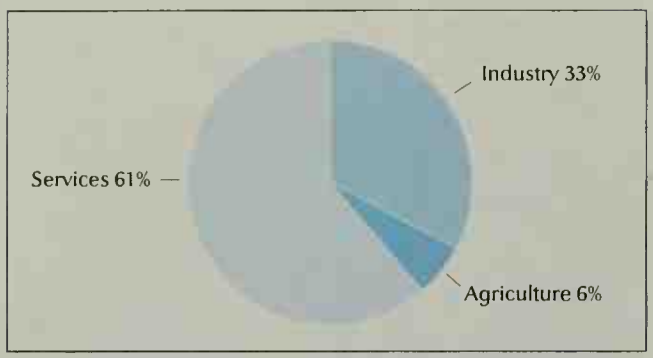
Economy

Natural resources. Hungary's chief resources include its fertile soil and its climate, which is generally favorable for agriculture. Farms cover about 65 percent of the land and produce most of the food the people need. About 20 percent of Hungary's land is forested. These forests cannot supply all the timber the country needs. Thus, large amounts of timber are imported.

Hungary's most important mineral deposits are of bauxite, the ore from which aluminum is made. The country also has deposits of coal, iron ore, manganese, natural gas, and oil. However, the deposits of these minerals are small or of low quality. Hungary thus imports additional supplies. Uranium, the country's main source of nuclear energy, was discovered in the Mecsek Mountains near Pécs in the 1950's. Uranium mines were developed with the assistance of the Soviet Union.

Hungary's electric power production does not meet its needs, and so extra power is imported. In the 1980's, Hungary began constructing nuclear reactors. Energy from the reactors and conservation help reduce Hungary's dependence on imported oil and coal.

Hungary's gross domestic product



Hungary's gross domestic product (GDP) was $45,728,000,000 in United States dollars in 1997. The GDP is the total value of goods and services produced within a country in a year. *Services* include financial, government, community, and personal services; trade; and transportation and communication. *Industry* includes construction and manufacturing, mining, and utilities. *Agriculture* includes agriculture, forestry, and fishing.

Production and workers by economic activities

Economic activities	Percent of GDP produced	Employed workers	
		Number of persons	Percent of total
Financial, government, community, & personal services	38	1,219,900	33
Manufacturing, mining, & utilities	28	988,700	27
Trade, hotels, & restaurants	13	617,700	17
Transportation & communication	10	310,000	9
Agriculture, forestry, & fishing	6	287,900	8
Construction	5	219,200	6
Total	100	3,643,400	100

Figures are for 1997.
Source: Hungarian Central Statistical Office.

© Peter Fodor, Red Dot

Technicians assemble computers at a plant in Székesfehérvár, in central Hungary. Electronic products are one of the country's leading exports.

© Hubertus Kanus, Photo Researchers

Wine grapes are harvested near Siklós in southwest Hungary. The country's fertile soil and its climate, which is favorable to agriculture, are among its chief natural resources.

Service industries employ about 60 percent of the workers. These industries include such economic activities as education, engineering, finance, health care, and trade. Hungary has several commercial banks, a national securities exchange, and a stock exchange in Budapest.

Engineering and trade are major employers in Hungarian service industries. Engineers help modernize Hungary's factories and manufactured products. Retail trade employs many people in the major cities. Important wholesale trade activities include exporting farm products and importing mineral products.

Manufacturing. The heaviest concentration of factories in Hungary is in the Budapest area. Hungary's chief manufactured products include buses and railroad equipment, electrical and electronic goods, food products, iron and steel, medical and scientific equipment, pharmaceuticals, and textiles.

In addition, Hungarian plants process much of the country's bauxite into alumina, which is the first step in producing aluminum. However, the second step—processing alumina into aluminum—is mostly done in other countries. Hungary lacks the large amounts of cheap electric power needed to process alumina into aluminum economically.

Agriculture. Crops account for about 60 percent of the value of Hungary's farm out put, and livestock accounts for about 40 percent. Hungary's chief crops include corn, potatoes, sugar beets, wheat, and wine grapes. Farmers raise more chickens and hogs than any other kind of livestock. Beef cattle, dairy cattle, and sheep are also important types of livestock in Hungary.

International trade. Hungary's economy depends heavily on international trade. The leading imports in-

clude advanced machinery, automobiles, chemicals, electric power, fertilizers, iron ore, livestock feed, natural gas, paper, and petroleum. Chief exports include alumina, electrical equipment, fruits and vegetables, meat, pharmaceuticals, steel, and transportation equipment, especially buses.

Hungary's main trading partners include Austria, France, Germany, and Italy. Russia is an important supplier of natural gas and petroleum.

Transportation. Hungary's railroad system is about 4,800 miles (7,800 kilometers) long. Hungary has more than 80,000 miles (130,000 kilometers) of roads, about half of which are surfaced. Its rivers and canals form a network of navigable waterways about 1,000 miles (1,600 kilometers) long.

Hungary has international airports in Budapest and near Siófok on Lake Balaton. Hungarian Airlines, the national airline, is owned partly by the government and partly by private investors.

Communication. Hungary has about 40 daily newspapers. The most important newspaper is *Népszabadság (People's Freedom).*

History

Early years. People have lived in what is now Hungary for thousands of years. But the history of the Hungarian state began in the late 800's. At that time, tribes of Magyars swept from the east into the middle Danube Basin—the great lowland region bordering the Danube River that comprises most of present-day Hungary. The tribes were led by a chief named Árpád. As the Magyars entered the area, they began to set up settlements.

During the early 900's, Magyar armies raided towns throughout much of Europe. But in 955, the German king Otto I defeated the invading Magyars. The Magyars then ended their raids.

The Kingdom of Hungary. About 970, Árpád's great-grandson Géza became leader of the Magyars. Géza began to organize the various Magyar tribes into a united nation. After Géza died, his son Stephen carried on the work. Stephen, who was a Roman Catholic, asked Pope Sylvester II to give him the title king of Hungary. The pope agreed, and Stephen I, Hungary's first king, was crowned in 1000.

As Hungary's king, Stephen made Roman Catholicism the country's official religion. For this work, the Catholic Church declared him a saint in 1083, 45 years after his death. As a result of Stephen's reign, Hungary became closely identified with the culture and politics of Western Europe.

Árpád's descendants ruled Hungary until 1301, when the last Árpád king died without an heir. During the 300 years of the reign of the Árpáds, Hungary became firmly established as a Christian state.

The country also faced its first great challenge from the east during this period. In 1241, armies of the Mongol Empire invaded Hungary. The Mongols were a warlike people of central Asia who had gradually extended their rule westward into eastern Europe. Within a few months, the Mongol armies had overrun much of Hungary. The death of the Mongols' ruler forced the invaders to withdraw in 1242. But they left much of the country in ruins. Under the leadership of the Árpád kings, Hungary gradually recovered.

After the death of the last Árpád king in 1301, Hungary remained an independent kingdom for 225 more years. One of the greatest kings during this period was Charles Robert, a member of the Italian branch of the Anjou dynasty. He ruled Hungary from 1308 to 1342. Charles Robert restored order in the country, which had been troubled by civil conflict since the end of the Árpád rule. He also weakened the power of the nobles and strengthened the monarchy. Hungary gained much land through the conquests of Charles Robert's son Louis I, called "the Great." But the land was lost during Louis's lifetime and shortly after his death in 1382.

John Hunyadi, a Hungarian nobleman of Romanian descent, led the Hungarians in defeating the Ottoman Empire in 1456. The Ottomans had been advancing into Europe since the mid-1300's. Hunyadi's son Matthias Corvinus became king of Hungary in 1458. Like Charles Robert, Matthias worked to strengthen royal power. Hungary prospered during his reign. It also became a center of the Renaissance, the great cultural movement that spread across Europe during the 1400's and 1500's.

A period of conflict and disorder followed Matthias's death in 1490. The Hungarian *Diet,* which was an assembly of noblemen similar to a parliament, gained much political power during this period, and the monarchy grew weak. At that time, most of Hungary's people were peasants who worked under wretched conditions for the nobles. As the nobles increased their power, they made the lives of the peasants even more miserable. The peasants revolted unsuccessfully against the nobles in 1514. After the revolt, the peasants were condemned to *serfdom* (a condition similar to slavery).

Ottoman Empire. Hungary, weakened by internal problems, was defeated by the Ottoman Empire in the Battle of Mohács in 1526. The defeat paved the way for the country's occupation by foreign troops. The Ottomans seized central Hungary soon after 1526. They made the eastern third of the country, a region called Transylvania, a *principality* (small state ruled by a prince) dependent on them. The Austrian Habsburgs, who had long wanted to make Hungary part of their empire, took the country's western and northern sections.

Habsburg rule. In the late 1600's, Habsburg forces drove the Ottomans out of most of Hungary. The Habsburgs gained complete control of the country in the early 1700's.

The Habsburgs governed Hungary, especially the Protestant sections, harshly. The Protestant Reformation had begun in Germany in the 1500's and gained many followers in Hungary. Transylvania, in particular, had developed a tradition of religious freedom, which allowed Protestants and Unitarians as well as Catholics to establish churches.

The harsh rule of the Habsburgs led to a nationwide uprising in 1703. The uprising was headed by Francis Rákóczi II, a Catholic and the son of a prominent family that included princes of Transylvania. The Habsburgs finally put down the revolt in 1711. However, it had persuaded them to relax their rule and to improve economic and political conditions in Hungary. During the rest of the 1700's, most Hungarians accepted and benefited from this change of policy.

In the early 1800's, Count Stephen Széchenyi led a movement to revive Hungarian culture and national

pride. He also promoted economic and social reforms. In the 1840's, Lajos Kossuth became the most important leader of the reform movement and eventually turned it into a drive for Hungarian independence.

During the 1840's, democratic and liberal nationalist movements were sweeping over Europe. Revolution broke out in France in 1848 and heightened the unrest in other European countries (see **Revolution of 1848**). In Hungary, a government responsible to parliament was formed with Austrian consent in 1848. Other changes were also made, including the freeing of the serfs.

But Hungary had not cut all ties with Austria, and disagreements between the two countries finally led Hungary to fight for its independence. Kossuth became head of a revolutionary Hungarian government, which declared the country's complete independence from Austria in April 1849. But the Austrians, aided by the Russians, defeated the Hungarian army in August of that year, and Hungary again came under Habsburg rule.

Austria-Hungary. Austria's power was soon shaken by two defeats. It lost a war against France and Italy in 1859 and against Prussia and Italy in 1866. In 1867, the Hungarians, led by Francis Deák, were thus able to force the emperor of Austria, Francis Joseph, to give Hungary equal status with Austria. Under this arrangement, which was called the *Dual Monarchy,* both countries had the same monarch and conducted foreign, military, and certain financial affairs jointly. But each country had its own constitutional government to handle all other matters.

The creation of Austria-Hungary was followed by a period of prosperity in the two countries. During the next 50 years, Hungary's economy, educational system, and cultural life developed rapidly.

Austria-Hungary included many Slavs, Romanians, and other national groups. These groups made up nearly half of Hungary's population. In the late 1800's and early 1900's, many of the national groups in Hungary began to demand the right of self-government. But most Hungarian politicians failed to heed these demands.

In 1914, a Serbian student from Bosnia-Herzegovina assassinated the heir to the Austro-Hungarian throne. Austria-Hungary suspected its southern neighbor Serbia was responsible for the killing. As a result, Austria-Hungary declared war on Serbia, marking the start of World War I (1914-1918). In the war, Germany, Bulgaria, and the Ottoman Empire supported Austria-Hungary, forming the Central Powers. The Central Powers fought Britain, France, Russia, Serbia, and other nations that made up the Allies. The United States entered the war on the Allied side in April 1917. See **World War I**.

Between world wars. A defeated Austria-Hungary signed an armistice on Nov. 3, 1918. On November 16, the Hungarian people revolted and declared Hungary a republic. Count Michael Károlyi became president. But Hungarian Communists and Socialists joined together to form a *coalition* government in March 1919. Károlyi resigned, and Béla Kun, leader of the Communists, took control of the new government as a dictator.

Kun's rule lasted only a few months. It collapsed largely because Kun could not defend Hungary against armed attacks by Romania, which sought Hungarian territory. Romanian troops occupied much of Hungary, including Budapest. In addition, most Hungarians did not support Kun's policies, which included taking over the country's factories and farms.

Late in 1919, Admiral Nicholas Horthy came to power. His conservative government lasted 25 years. Under Horthy, Hungary again became a monarchy, though it had no king. Instead, Horthy ruled as *regent* (temporary ruler in the place of a monarch).

Hungary and the Allies signed the Treaty of Trianon in 1920. The treaty was part of the World War I peace settlements. It stripped Hungary of more than two-thirds of its territory. Parts of Hungary went to Czechoslovakia, Romania, Austria, and the Kingdom of the Serbs, Croats, and Slovenes (later called Yugoslavia). Hungary's present boundaries are about the same as those set by the treaty. See **Trianon, Treaty of.**

Under the Treaty of Trianon, about one-third of the Hungarian population was left outside of the country's borders. They continued to be a source of tension with the new governments of neighboring countries.

World War II. The rise of Nazi Germany in the 1930's had far-reaching effects on Hungary. Adolf Hitler, the German dictator, promised the return of some territory that Hungary had lost under the Treaty of Trianon. Beginning in 1938, Hitler allowed Hungary to take parts of

Important dates in Hungary

Late 800's The Magyars conquered Hungary.

1000 Stephen I became Hungary's first king and converted the country to Roman Catholic Christianity.

1241 The Mongols invaded Hungary.

1458-1490 Matthias Hunyadi ruled Hungary and helped make it a center of Italian Renaissance culture.

1526 The Ottoman Empire defeated Hungary in the Battle of Mohács. Soon afterward, the Ottomans occupied central and eastern Hungary.

1600's-early 1700's Austrian Habsburg forces drove the Ottomans out of Hungary and took control of the country.

1703-1711 Francis Rákóczi II led an unsuccessful uprising to gain Hungarian independence.

1848 Lajos Kossuth led an anti-Habsburg revolution, which was defeated the following year.

1867 The Dual Monarchy of Austria-Hungary was established.

1914-1918 Austria-Hungary was defeated in World War I.

1918 Hungary became a republic.

1919 Béla Kun established the first Hungarian Communist government. It lasted only a few months.

1919-1944 Admiral Nicholas Horthy, a conservative, ruled Hungary in the place of a king as a *regent* (temporary ruler).

1941 Hungary entered World War II on Germany's side.

1944 Germany, which mistrusted Hungary as an ally, occupied the country.

1945 Hungary and the Allies signed an armistice.

1946 Hungary again became a republic. The new government started political, economic, and social reforms.

1946-1949 Hungarian Communists gradually gained control of the government.

1947 The Allies signed a peace treaty with Hungary that confirmed the terms of the 1945 armistice.

1955 Hungary became a member of the United Nations.

1956 Soviet forces crushed an anti-Communist revolution in Hungary.

1990 The 40-year rule of the Communist Party ended.

1999 Hungary joined the North Atlantic Treaty Organization (NATO), a military alliance of Western nations.

Czechoslovakia, Romania, and Yugoslavia. In April 1941, Hungary aided Hitler in an attack on Yugoslavia and so entered World War II. It joined Germany, Italy, and other Axis countries in fighting the Allies, which included Britain, France, and, by the end of 1941, China, the Soviet Union, and the United States. Japan entered the war on the Axis side in December 1941.

By 1943, Hitler no longer considered Hungary a reliable ally. He seized the country in March 1944. More than 500,000 Hungarian Jews were shipped to German concentration camps, where most of them were put to death in gas chambers. The Germans jailed Horthy in October and set up a Hungarian Nazi government.

The Soviet Union invaded Hungary late in 1944, and Hungary and the Allies signed an armistice in January 1945. Hungary agreed to give up all the territory it had gained since 1938. Hungary and the Allies signed a peace treaty in 1947. See **World War II.**

Communist Hungary. Elections were held in November 1945. Early the next year, Hungary was declared a republic. After the November elections, a coalition government was formed. This government introduced many social and economic reforms, including land distribution among the peasants. The coalition consisted of the Smallholder, Social Democratic, Communist, and National Peasant parties. The Smallholder Party had won a clear majority of the votes in the elections. However, Communists gradually gained control of the government, largely because of the continued presence of Soviet troops in Hungary.

Elections were held again in 1947, and the Communists again failed to win a majority of the votes. But by then, Communist Party leaders held important positions at all levels of government and in major nongovernmental organizations. Only a small percentage of Hungary's people belonged to the party. However, Communist Party members held enough key government posts to extend their control over the country. The general secretary, head of the Communist Party, became the most powerful leader in Hungary.

The Communist leaders made the Communist Party the country's only legal political party, and they banned all opposition parties. In 1949, the Communists gave Hungary a constitution patterned on the Constitution of the Soviet Union.

Before World War II (1939-1945), Hungary had been chiefly an agricultural country. After the Communists gained control of the government, they took control of many industries and farms and began to manage the nation's economy. To carry out their program, they started a series of highly detailed plans that stressed industrial development. As a result, Hungary became increasingly industrialized. Many Hungarians moved from the rural areas to cities and towns to work in the country's growing industries.

The government's economic plans required frequent readjustment, however. By the early 1950's, for example, the country's industries could not meet the government's extremely high production goals. Farm production lagged because the government did little to promote agriculture. The people of Hungary reacted strongly against these policies, and the government was forced to set more realistic industrial goals and place more emphasis on agriculture.

While Hungary was under Communist control, most of the country's farmland was privately owned. The rest of the farmland was organized into large state farms and collective farms.

On state farms, the government owned the land and appointed a director to manage each farm. Workers received a salary. On collective farms, many families worked together. The workers owned the equipment and some of the farm's land as a group. Each member received a wage and a share of the farm's earnings.

Matthias Rákosi, head of the Communist Party and head of the Hungarian government, ruled as a dictator in the early 1950's. His policies nearly ruined the economy and produced widespread discontent among the people. In 1953, Imre Nagy replaced Rákosi as head of the government. But Rákosi remained head of the party. Nagy adopted policies that gave Hungarians more personal freedom and that aimed at improving their living conditions. But Rákosi and other party members opposed these reforms. As the leader of the Communist Party, Rákosi forced Nagy out of the government and the party in 1955.

Unsuccessful revolution. Rákosi's policies again caused unrest, especially among writers, young people, and others deeply concerned with human rights and freedom of expression. Rákosi was replaced as party leader in mid-1956, but his policies were continued.

In October, discontent with these policies erupted into street fighting in Budapest. The revolution spread swiftly through Hungary. Many political prisoners were freed, including Joseph Cardinal Mindszenty, head of the Catholic Church in Hungary. The Communists had jailed him in 1949.

Nagy again became prime minister and declared Hungary to be a neutral country. But the new government lasted only a few days. Soviet forces poured into the country and put down the uprising in November.

Thousands of Hungarians were killed or jailed as a result of the revolution. About 200,000 fled Hungary.

Hulton Getty/Archive Photos

Soviet troops and tanks surrounded the Parliament Building in Budapest during the 1956 anti-Communist uprising. Soviet military forces quickly brought the rebellion to an end.

Mindszenty took refuge in the U.S. Legation (now the U.S. Embassy) in Budapest, where he lived until allowed to leave Hungary in 1971. Nagy and his co-workers were charged with helping plot the revolution. They were convicted of treason and were executed in 1958.

Beginnings of change. After the 1956 revolution, the Soviet Union kept Hungary under tight control. János Kádár, the new head of the Communist Party, served as prime minister from 1956 to 1958 and from 1961 to 1965. At first, he followed stern policies designed to prevent further revolutionary acts. But in the 1960's, Kádár's government tried to win increased support from the people by easing some of the restrictions on cultural, economic, and social life.

In 1968, the government adopted a new economic program that introduced features of a free market system into the socialized economy. The program was called the New Economic Mechanism (NEM). At first, the NEM resulted in higher economic growth and an improved standard of living. But opposition to the NEM within the Soviet and Hungarian Communist parties prevented the full development of the program. As a result, it ended by the early 1980's.

In the 1970's, an increase in the price of petroleum and other raw materials resulted in inflation, slower economic growth, and a serious trade deficit. By the late 1970's, living standards had begun to decline as a result of the worsening economy. Kádár opposed further economic reforms. His unwillingness to give in to the wishes of an embittered public led to his replacement as head of the Communist Party by Károly Grósz in 1988. Grósz had been appointed prime minister in 1987. Miklós Németh replaced Grósz as prime minister at the end of 1988. New political parties appeared, and parties that had been destroyed by the Communists in the late 1940's began to reorganize.

In an attempt to reduce the trade deficit and restore economic growth, the government instituted sweeping changes in the economy during the 1980's. Company managers were allowed more power in decision making. The government stopped funding some companies that lost money and allowed successful companies to pay workers higher wages. It encouraged the formation of private businesses and businesses that formed partnerships with foreign companies. In the mid-1990's, the trade deficit began to decline.

In 1989, the Communist Party declared that the trial of Imre Nagy and his co-workers and their executions in 1958 had been illegal. Hungary's Supreme Court invalidated the unlawful sentences. Nagy and his co-workers were ceremoniously reburied with honor in June 1989.

End of one-party rule. In 1988, the Communist Party's power and authority began to erode. Public pressure forced party leaders to allow other political parties to form. In October 1989, the Communist Party ended its monopoly on power in the country. It declared itself socialist and renamed itself the Hungarian Socialist Party. Some Communist Party members opposed the move. They formed a new Communist organization, which came to be called the Hungarian Workers' Party.

Later in October, Hungary's National Assembly made sweeping revisions in its Constitution. The revisions increased the freedom of the people. For example, the changes granted the people complete religious freedom. The revisions also changed the structure of the government from a one-party Communist state to a multiparty democratic, parliamentary system.

At that time, it was common practice for the National Assembly to elect 21 of its members to serve as the Presidential Council. The head of the council acted as Hungary's head of state. But the changes to the Constitution abolished the Presidential Council and created the office of president. The president became the country's top government official. Mátyás Szúrös was chosen to serve as president until multiparty elections were held.

Multiparty elections. Hungary's first multiparty elections since 1949 were held in March and April 1990. The Hungarian Democratic Forum—a non-Communist party—won a majority of the parliamentary seats. The Hungarian Democratic Forum formed a coalition government with two smaller non-Communist parties, the Independent Smallholders' Party and the Christian Democratic People's Party. The National Assembly elected Árpád Göncz as Hungary's new president.

In 1990, Hungary's newly elected non-Communist government began to introduce reforms to further limit government control over businesses. These reforms included the sale of state-owned businesses and were designed to increase competition and productivity in Hungary's economy.

By the mid-1990's, the government had divided up most of the state farms and collective farms and had sold the parcels to individual farmers. The remaining collective farms were run by businesses, and the remaining state farms were held by the government.

In parliamentary elections held in 1994, the Hungarian Socialist Party, made up mainly of former members of the Communist Party, won a majority of seats. The party formed a coalition government with the Alliance of Free Democrats, a smaller liberal party. The coalition pledged to continue the reforms begun in 1989.

In 1995, Göncz was reelected president. The Hungarian government remained concerned about the position of the large number of Hungarians who formed minorities in neighboring states. In 1995, Hungary signed a treaty with Slovakia to protect the rights of Hungarians within that country. Hungary's parliament ratified the pact in 1995, and the parliament of Slovakia ratified it in 1996. Also in 1996, a similar treaty between Hungary and Romania went into effect.

Recent developments. In 1998 parliamentary elections, the Federation of Young Democrats-Hungarian Civic Party, a moderately conservative party, won the most seats in the National Assembly. In 1999, Hungary became a member of the North Atlantic Treaty Organization (NATO), a military alliance of Western countries. In 2000, Ferenc Madl was elected president. As a result of elections in 2002, a coalition of Hungarian Socialists and Free Democrats again took control of the National Assembly.

Janusz Bugajski

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Questions

When was Hungary's first king crowned?
What is *goulash?*
How do the surface features of the Great Plain differ from those of Transdanubia?
What are Hungary's most important mineral deposits?
Who is Hungary's most powerful government official?
What Hungarian lake is the largest lake in central Europe?
Why were the Communists able to gain control of Hungary's government after World War II?
Who were the first Hungarians?
What political role did some Hungarian writers play in the period before the 1956 revolution?

Additional resources

Hoensch, Jörg K. *A History of Modern Hungary, 1867-1994.* 2nd ed. Addison Wesley Longman, 1996.
Steins, Richard. *Hungary.* Benchmark Bks., 1997. Younger readers.
Várdy, Steven B. *Historical Dictionary of Hungary.* Scarecrow, 1997.

Hunger is an unpleasant, often painful sensation caused by the body's need for food. The most familiar hunger pains are stomach cramps, which are produced by strong contractions of the stomach muscles. Many experts believe that hundreds of millions of children and adults throughout the world suffer from hunger. This article discusses both the physical and social aspects of hunger.

Certain chemicals produced in the brain and other parts of the nervous system play an important role in regulating the sensation of hunger in human beings. An imbalance of these chemicals may increase or decrease the sensation. The amount of *glucose* (sugar) in the blood also affects hunger. People may become hungry if their bodies have less than a normal amount of glucose.

People need many substances besides glucose to avoid being hungry. These substances include vitamins, minerals, and amino acids. *Internal chemoreceptors* are sensitive receivers in the brain, kidneys, digestive system, and elsewhere in the body that respond to the amount of available glucose and other needed substances (see **Senses**). Nerve impulses from these receptors reach a region of the brain stem called the *hypothalamus.* In the hypothalamus, these impulses are translated into detection of a need for the substances that are lacking. This action may cause a person to eat the needed foods.

Social habits also affect hunger and eating in human beings. People eat at certain times, and they usually eat only certain foods. Sometimes signals from internal receptors that do not give information on hunger are interpreted as hunger. A person may then overeat and become overweight.

Hunger is one of the world's main social problems. In both developing and developed countries, millions of people are too poor to buy enough food. Furthermore, the world's growing population creates a greater demand for food every year. But droughts, floods, or other natural disasters destroy many food crops annually. In addition, most of the developing countries of Africa, Asia, and Latin America lack the expertise and equipment needed to produce adequate food supplies for most of their people.

Hunger differs from *famine,* which is a prolonged shortage of food in a particular geographic area. For a discussion of the causes and effects of famine and the methods of fighting it, see **Famine.** Bruce P. Halpern

See also **Developing country; Food supply; Nutrition; Poverty; Weight control.**

Hunt, H. L. (1889-1974), an American oil producer, became one of the richest people in the world. He was noted both for his great wealth and for his extremely conservative political views.

Haroldson Lafayette Hunt was born in Vandalia, Illinois. He had little formal schooling, but his mother, a former schoolteacher, taught him at home. Hunt made his fortune in the 1920's by *speculating* (buying and selling at great risk) in the newly discovered Arkansas oil fields. He founded the Hunt Oil Company and controlled many smaller firms. In 1958, Hunt established a radio program called "Life Line" that broadcast his views to millions of people. Among other things, he believed that the wealthy should have greater voting power than the poor, and that Calvin Coolidge was the most recent successful president. Leonard S. Silk

Hunt, Leigh (1784-1859), was an English journalist, essayist, and poet. He supported such English Romantic poets as John Keats and Percy Bysshe Shelley when they were largely ignored or ridiculed. Hunt edited several periodicals, and much of his best work appeared as literary and informal essays in these publications. Only a few of Hunt's poems are still read, notably "The Story of Rimini" (1816) and "Abou Ben Adhem" (1834). He described his friendships with major Romantic and early Victorian writers in his *Autobiography* (1850).

James Henry Leigh Hunt was born in Southgate, a

Joan Menschenfreund, The Stock Market

The Breakers is a mansion built for Cornelius Vanderbilt in 1895. Richard Morris Hunt designed the 70-room home in Newport, Rhode Island, to reflect Italian Renaissance palace architecture.

London suburb. With his brother John, Hunt founded a liberal weekly newspaper called the *Examiner* in 1808. Hunt was imprisoned from 1813 to 1815 for his attacks on the future King George IV in the *Examiner.*

Richard J. Dunn

Hunt, Richard Morris (1827-1895), was an American architect. He was largely responsible for shifting American architecture away from English sources and toward French influences. Hunt is perhaps best known for the magnificent summer houses that he designed for wealthy clients, especially the Vanderbilt family.

Many of the mansions that Hunt designed, such as George Washington Vanderbilt's estate near Asheville, North Carolina, were patterned after the French Renaissance château. Hunt designed other mansions in New York and in Newport, Rhode Island, notably The Breakers and Marble House. In addition, Hunt designed the pedestal for the Statue of Liberty and the front wing of the Metropolitan Museum of Art in New York City. See North Carolina (picture: The Biltmore Estate in Asheville); Statue of Liberty.

Hunt was born in Brattleboro, Vermont. He was the first American architect trained at the École des Beaux-Arts in Paris. Hunt opened a studio in New York City in 1857, where he conducted workshops modeled after those of the École These workshops represented the first such education in architecture in the United States.

Leland M. Roth

Hunting is the attempt to capture or kill wild animals. At one time, people had to hunt for their food. Today, most people hunt because they enjoy it as a sport. Hunting enthusiasts see it as a contest between the hunter and the hunted. Hunters have weapons, but animals move faster, know the outdoors better, and can smell and hear better.

Kinds of hunting depend on the game being hunted, the location, and the methods used to catch the animal. Upland hunters shoot pheasants, quail, grouse, and other game birds found in farm country. Waterfowl hunters shoot ducks and geese from boats or from *blinds,* hiding places made from such materials as tall grass or twigs. These hunters also use *decoys* (artificial ducks) and calls to deceive ducks and lure them closer. Other hunters use calls that imitate injured prey to attract *carnivorous* (meat-eating) animals, such as bears and mountain lions.

Most hunters use a rifle or shotgun to kill game. In North America, *high-velocity* (high-speed) rifles are used to hunt such big game as white-tailed deer, black bear, mule deer, elk, and pronghorns. People use small-caliber rifles to shoot smaller game, including cottontail rabbits, foxes, and squirrels. Shotgun shells filled with small pellets called *bird shot* are used to shoot ducks, upland game, and migratory game birds. Deer hunters sometimes use larger shot called *buckshot.* Many people also hunt with bows and arrows, pistols, muzzle-loading rifles, and crossbows.

Some types of dogs are bred especially for hunting. A *bird dog* is trained to locate birds or to bring back birds shot by the hunter. *Hounds* are trained to follow the scent of game animals, including cottontail rabbits and raccoons. *Pointing dogs,* such as pointers and Brittanys, find game by scent and then *point* (alert the hunter to the game by standing in a rigid position). *Retrievers* swim to get waterfowl shot by the hunter.

Opposition to hunting. Some people say hunting unnecessarily kills animals and endangers species. They argue that hunters could enjoy nature and test their skills by tracking and photographing animals instead of killing them. However, hunters say the sport helps keep deer and other animals from multiplying so rapidly that they exceed the food supply or even damage their environment. State and federal laws prohibit the hunting of endangered or threatened species.

Game laws. All states in the United States and Mexico and all provinces in Canada have laws that regulate hunting. These laws control the kind and number of animals that can be killed, the hunting methods to be used, and when and where game can be hunted. In the United States, the state agencies that enforce these laws are funded mostly by license fees, and partly by federal taxes on hunting equipment. States and the federal government have also set up *refuges,* areas where strict hunting rules apply or hunting is prohibited.

William R. Quimby

Related articles in World Book include:

- Ammunition
- Conservation (Africa)
- Dog (Sporting dogs; pictures)
- Fox hunting
- Fur (Trapping)
- Game
- Indian, American (pictures)
- Inuit (Hunting and fishing)
- Poaching
- Prehistoric people (The first human beings)
- Safari
- Shotgun
- Trapping
- Wildlife conservation

Additional resources

Schneck, Marcus. *The North American Hunter's Handbook.* 1991. Reprint. Random Hse., 1995.

Sparano, Vin T. *Complete Outdoors Encyclopedia.* 4th ed. 1998. Reprint. St. Martin's, 2000. Includes section on hunting.

Huntington (pop. 51,475) ranks as the second largest city in West Virginia. Only Charleston has more people. Huntington lies along the Ohio River, on the western border of West Virginia. For the location of Huntington, see **West Virginia** (political map). Huntington ranks as the largest community of a metropolitan area that extends into Kentucky and Ohio and has a population of 315,538.

Huntington is an industrial, shipping, and service center. Goods produced by its factories include chemicals, clothing, glass, nickel alloys, and steel. Coal and various other products from nearby areas are shipped from Huntington along the Ohio River. Huntington serves as a regional health care center. It has a number of hospitals and health clinics. Freight and passenger railroads and a major airport nearby serve the city. Huntington is the home of Marshall University, which has a campus of about 80 acres (32 hectares) near the central business district.

Collis P. Huntington, president of the Chesapeake and Ohio Railroad, founded the city in 1871. Huntington is the seat of Cabell County and has a strong mayor form of government. Mack H. Gillenwater

Huntington, Samuel (1731-1796), was a Connecticut signer of the Declaration of Independence. He also represented Connecticut in the Continental Congress from 1776 to 1781, serving as president of the congress from 1779 to 1781.

Huntington also was a member of Connecticut's delegation to the Congress of the Confederation from 1781 to 1784. In 1784, he was appointed chief justice of the superior court of Connecticut. Huntington served as governor of Connecticut from 1786 to 1796. He was born in Windham, Connecticut. Gary D. Hermalyn

Huntington's disease is a severe hereditary disorder of the nervous system. It destroys brain cells and causes involuntary body movements, mental disturbances, and eventual death. The disorder was named for George Huntington, an American physician, who first described it in 1872. The condition is also called *Huntington's chorea* (see **Chorea**).

The symptoms in most cases of the disease begin when the person is from 35 to 40 years old. But some cases start in childhood or old age. Patients live an average of 15 years after the first symptoms of the disease appear.

The first physical symptom of the disease may be slight clumsiness or restlessness. Later, muscles in the face and hands begin to move involuntarily. Involuntary facial movements include pouting of the lips, irregular raising of the eyelids, and puffing out of the cheeks. As Huntington's disease progresses, the involuntary movements become stronger and eventually involve the whole body. The head, shoulders, arms, and legs jerk uncontrollably. When the patient walks, voluntary and involuntary movements combine and produce lurching, dancelike steps. Early mental symptoms of the disease include dullness and irritability, and carelessness about personal grooming. The disease gradually destroys the patient's intellect and memory. Severe mental illness may develop.

The patient may finally lose all muscle control and mental ability. Death results from pneumonia, choking, or other complications of the disease. Some patients with Huntington's disease become depressed and commit suicide.

Huntington's disease is caused by an abnormal gene located on one of a pair of chromosomes designated as *chromosome 4*. Anyone who inherits this gene will eventually be stricken by the disorder. Each child of a patient with the disease has a 50 percent chance of inheriting the gene.

Physicians are not certain how widespread Huntington's disease is, because some patients may be misdiagnosed as suffering from schizophrenia or some other mental illness. Experts estimate that of every 100,000 people, 2 to 9 have the gene for the disease. Researchers have developed a test to identify people who carry the gene but who have not yet developed the disease. The test requires tissues or fluids from family members of the test subject, including samples from a family member known to have the disease and from one who does not. As a result, the test is not useful to many people who carry the gene. Huntington's disease has no cure. However, many of the symptoms of Huntington's disease may be eased by the use of drugs and by other forms of treatment. William J. Weiner

Huntsville, Alabama (pop. 158,216; met. area pop. 342,376), is often called *Rocket City, U.S.A.* The Redstone Arsenal, the rocket and guided-missile center of the United States Army, lies just southwest of Huntsville. Wernher von Braun and other scientists developed the nation's first large guided missiles there during the 1950's. In the 1960's, von Braun's team designed the rockets that carried U.S. astronauts to the moon. Huntsville covers 154 square miles (399 square kilometers) in northern Alabama. For the location of Huntsville, see **Alabama** (political map).

The city is the home of Alabama Agricultural and Mechanical University, Oakwood College, and the University of Alabama at Huntsville. Huntsville has a symphony orchestra and several theatrical groups. The U.S. Space and Rocket Center in Huntsville exhibits the world's largest collection of space-related materials (see **Alabama** [picture]). The area's leading private industries produce personal computers, computer software, and electronic equipment for automobiles. Huntsville is the county seat of Madison County. The city has a mayor-council form of government.

Cherokee and Chickasaw Indians lived in the area before white settlers arrived. In 1805, John Hunt of Virginia set up the first permanent settlement there. He chose the site because of its fertile soil and a big spring. The settlement, called Hunt's Spring, was renamed Twickenham in 1809. In 1811, it was incorporated and renamed Huntsville for Hunt. The city was Alabama's first state capital, in 1819 and 1820.

Huntsville, with an economy based on cotton and textiles, grew steadily during the 1800's and early 1900's. The population of the city jumped from about 16,000 in 1950 to more than 72,000 in 1960. This dramatic increase in population resulted from guided-missile research at the arsenal and industrial growth in the area. In 1960, the National Aeronautics and Space Administration opened the George C. Marshall Space Flight Center at the arsenal. Huntsville's Von Braun Civic Center opened in 1975. A new public library was completed in the city in 1987.

John Ehinger

Hunza, *HUN zuh,* is an area in the northern tip of Pakistan. It lies in the Pakistan-controlled part of Kashmir, near the borders of Afghanistan and China. Hunza covers about 3,900 square miles (10,101 square kilometers). Karimabad is the largest city of Hunza.

Hunza consists of a long, narrow valley in the Karakoram mountain range. The people of Hunza are called *Hunzukuts.* Most of them are farmers who grow such crops as barley, grapes, plums, and wheat. The chief industries of Hunza are the production of woolen cloth and fine handicrafts.

Many of Hunza's people live more than 90 years. They believe that mineral-rich mountain water and a simple diet contribute to their long life. Their diet consists chiefly of fruits, such as apricots and peaches, and grains, nuts, and vegetables. The majority of the people speak a language called *Burushaski.* They have no written language. Most Hunzukuts are Muslims, and Islamic religious holidays are important to them.

No one knows who first lived in what is now Hunza. According to legend, three soldiers from the army of Alexander the Great settled there with their Persian wives during the 300's B.C. For hundreds of years, Hunza was an isolated state ruled by a *mir* (prince). Pakistan gained control of Hunza in 1949, as a result of a United Nations truce that ended fighting between Pakistan and India in Kashmir (see **Kashmir**). The mir was allowed to rule over local matters until 1974, when Pakistan took over complete control. Robert LaPorte, Jr.

Hurdling is a track and field race in which runners jump over fencelike obstacles called *hurdles.* Most races have 10 hurdles that stand at equal intervals on the track.

There are two types of hurdle races: intermediate and high. Intermediate-hurdle races are 300 meters in high school and 400 meters in all other levels of competition. The hurdles are 36 inches (91 centimeters) high for men and 30 inches (76 centimeters) high for women. Most high-hurdle races for men are 55 meters indoors and 110 meters outdoors. Women run a 100-meter high-hurdle race. In men's competition, the hurdles are 42 inches (106 centimeters) high. High hurdles are 39 inches (99 centimeters) high in high school. High hurdles in women's races are 33 inches (84 centimeters) high.

Larry Day

High-hurdlers leap over the final hurdle in this exciting track event. Outstretched arms maintain balance and help the runners to "scissor" their legs over the 42-inch (106-centimeter) bars.

In men's high-hurdle races, the first hurdle is 15 yards (13.72 meters) from the starting line in the 110-meter event. In the women's high hurdles, the first hurdle is 13 meters from the starting line. In all intermediate-hurdle races, the first hurdle stands 45 meters from the starting line.

In a hurdle race, runners must adjust their stride so that they clear the hurdle without breaking stride. The race begins from a sprinting position. Runners jump over the hurdle straight on. The lead leg goes over the hurdle first, and the other leg is brought up behind so it also clears the hurdle. Runners keep their speed and gain momentum and balance by thrusting one or both arms toward the lead leg. Runners drop the lead leg down as they bring their trailing leg through, so that they are in a running position as they finish jumping over the hurdle.

Hurdlers must run in lanes. They are disqualified if they allow a foot or leg to trail along the side of a hurdle or if they clear a hurdle that is not in their lane. Runners are not penalized for knocking down hurdles in their own lane. Michael Takaha

For hurdling championship figures, see the tables with **Track and field** and **Olympic Games.**

Hurdy-gurdy. See **Hand organ.**

Huron, Lake. See **Lake Huron.**

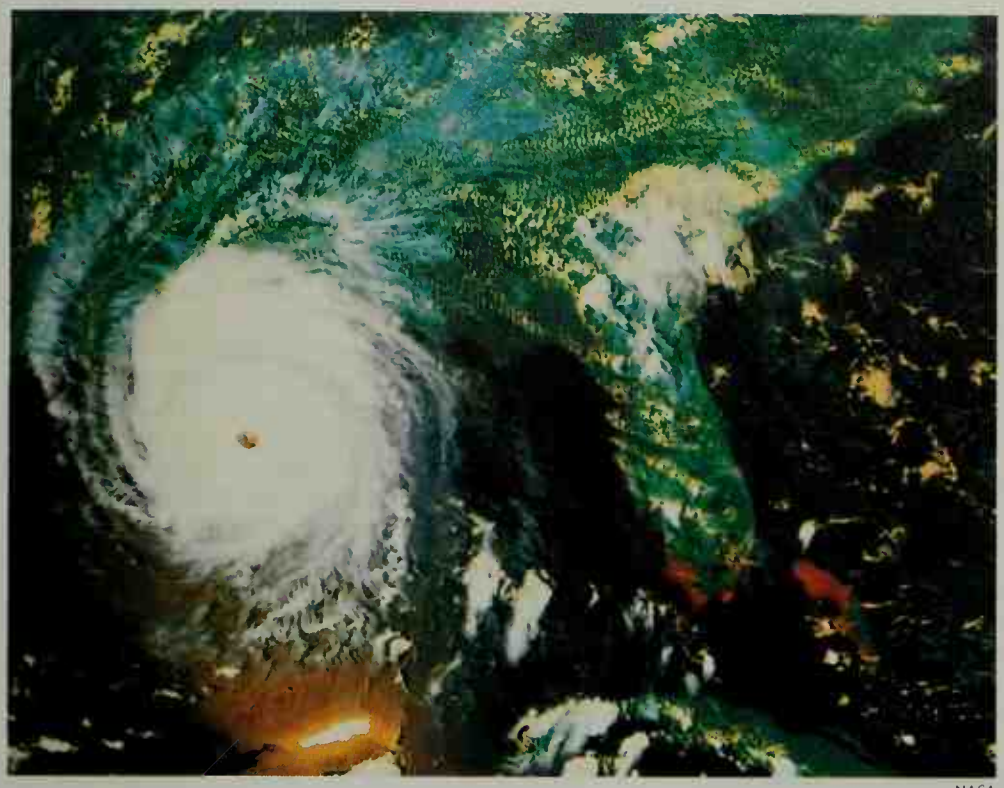
Huron Indians. See **Ontario** (History).

Hurricane is a powerful, swirling storm that begins over a warm sea. Hurricanes form in waters near the equator, and then they move toward the poles. When a hurricane hits land, it can cause great damage through fierce winds, torrential rain, flooding, and huge waves crashing ashore.

The winds of a hurricane swirl around a calm central zone called the *eye* surrounded by a band of tall, dark clouds called the *eyewall.* The eye is usually about 10 to 20 miles (16 to 32 kilometers) in diameter and is free of rain and large clouds. In the eyewall, large changes in pressure create the hurricane's strongest winds. These winds can reach nearly 200 miles (320 kilometers) per hour. Damaging winds may extend 250 miles (400 kilometers) from the eye.

Hurricanes are referred to by different labels, depending on where they occur. They are called *hurricanes* when they happen over the North Atlantic Ocean, the Caribbean Sea, the Gulf of Mexico, or the Northeast Pacific Ocean. Such storms are known as *typhoons* if they occur in the Northwest Pacific Ocean, west of an imaginary line called the International Date Line. Near Australia and in the Indian Ocean, they are referred to as *tropical cyclones.*

Hurricanes are most common during the summer and early fall. In the Atlantic and the Northeast Pacific, for example, August and September are the peak hurricane months. Typhoons occur throughout the year in the Northwest Pacific but are most frequent in summer. In the North Indian Ocean, tropical cyclones strike in May and November. In the South Indian Ocean, the South Pacific Ocean, and off the coast of Australia, the hurricane season runs from December to March. Approximately 85 hurricanes, typhoons, and tropical cyclones occur in a year throughout the world. In the rest of this article, the term *hurricane* refers to all such storms.



NASA

Hurricane winds swirl about the *eye,* a calm area in the center of the storm. The main mass of clouds shown in this photograph measures almost 250 miles (400 kilometers) across. The hurricane, named Andrew, struck the Bahamas, Florida, and Louisiana in 1992, killing 54 people and causing billions of dollars in damage.

Hurricane conditions

Hurricanes require a special set of conditions, including ample heat and moisture, that exist primarily over warm tropical oceans. For a hurricane to form, there must be a warm layer of water at the top of the sea with a surface temperature greater than 80 °F (26.5 °C).

Warm seawater evaporates and is absorbed by the surrounding air. The warmer the ocean, the more water evaporates. The warm, moist air rises, lowering the *atmospheric pressure* of the air beneath. In any area of low atmospheric pressure, the column of air that extends from the surface of the water—or land—to the top of the atmosphere is relatively less dense and therefore weighs relatively less.

Air tends to move from areas of high pressure to areas of low pressure, creating wind. In the Northern Hemisphere, the earth's rotation causes the wind to swirl into a low-pressure area in a counterclockwise direction. In the Southern Hemisphere, the winds rotate clockwise around a low. This effect of the rotating earth on wind flow is called the *Coriolis effect.* The Coriolis effect increases in intensity farther from the equator. To produce a hurricane, a low-pressure area must be more than 5 degrees of latitude north or south of the equator. Hurricanes seldom occur closer to the equator.

For a hurricane to develop, there must be little *wind shear*—that is, little difference in speed and direction between winds at upper and lower elevations. Uniform winds enable the warm inner core of the storm to stay intact. The storm would break up if the winds at higher elevations increased markedly in speed, changed direction, or both. The wind shear would disrupt the budding hurricane by tipping it over or by blowing the top of the storm in one direction while the bottom moved in another direction.

The life of a hurricane

Meteorologists (scientists who study weather) divide the life of a hurricane into four stages: (1) tropical disturbance, (2) tropical depression, (3) tropical storm, and (4) hurricane.

Tropical disturbance is an area where raincloud are building. The clouds form when moist air rises and becomes cooler. Cool air cannot hold as much water vapor as warm air can, and the excess water changes into tiny droplets of water that form clouds. The clouds in a tropical disturbance may rise to great heights, forming the towering thunderclouds that meteorologists call *cumulonimbus clouds.*

Cumulonimbus clouds usually produce heavy rains that end after an hour or two, and the weather clears rapidly. If conditions are right for a hurricane, however, there is so much heat energy and moisture in the atmosphere that new cumulonimbus clouds continually form from rising moist air.

Tropical depression is a low-pressure area surrounded by winds that have begun to blow in a circular pattern. A meteorologist considers a depression to exist when there is low pressure over a large enough area to be plotted on a weather map. On a map of surface pressure, such a depression appears as one or two circular *isobars* (lines of equal pressure) over a tropical ocean. The low pressure near the ocean surface draws in warm, moist air, which feeds more thunderstorms.

The winds swirl slowly around the low-pressure area at first. As the pressure becomes even lower, more warm, moist air is drawn in, and the winds blow faster.

Tropical storm. When the winds exceed 38 miles (61 kilometers) per hour, a tropical storm has developed. Viewed from above, the storm clouds now have a well-defined circular shape. The seas have become so rough

that ships must steer clear of the area. The strong winds near the surface of the ocean draw more and more heat and water vapor from the sea. The increased warmth and moisture in the air feed the storm.

A tropical storm has a column of warm air near its center. The warmer this column becomes, the more the pressure at the surface falls. The falling pressure, in turn, draws more air into the storm. As more air is pulled into the storm, the winds blow harder.

Each tropical storm receives a name. The names help meteorologists and disaster planners avoid confusion and quickly convey information about the behavior of a storm. The World Meteorological Organization (WMO), an agency of the United Nations, issues four alphabetical lists of names, one for the North Atlantic Ocean and the Caribbean Sea, and one each for the Eastern, Central, and Northwestern Pacific. The lists include both men's and women's names that are popular in countries affected by the storms.

Except in the Northwestern and Central Pacific, the first storm of the year gets a name beginning with *A*—such as Tropical Storm Alberto. If the storm intensifies into a hurricane, it becomes Hurricane Alberto. The second storm gets a name beginning with *B*, and so on through the alphabet. The lists do not use all the letters of the alphabet, however, since there are few names beginning with such letters as Q or U. For example, no Atlantic or Caribbean storms receive names beginning with Q, U, X, Y, or Z.

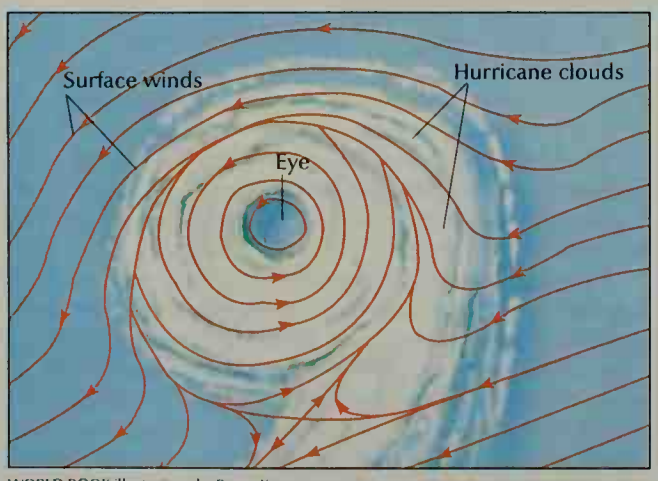
Because storms in the Northwestern Pacific occur throughout the year, the names run through the entire alphabet instead of starting over each year. The first typhoon of the year might be Typhoon Nona, for example. The Central Pacific usually has fewer than five named storms each year.

The system of naming storms has changed since 1950. Before that year, there was no formal system. Storms commonly received women's names and names of saints of both genders. From 1950 to 1952, storms were given names from the United States military alphabet—Able, Baker, Charlie, and so on. The WMO began to use only the names of women in 1953. In 1979, the WMO began to use men's names as well.

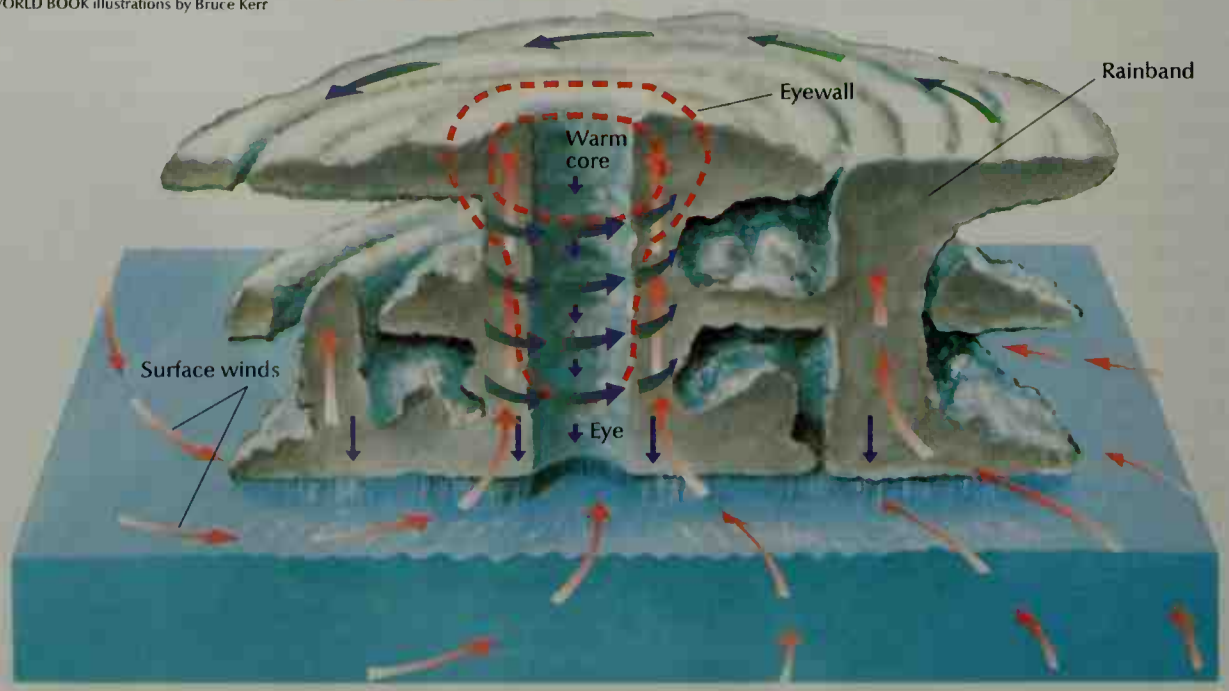
Hurricane. A storm achieves hurricane status when its winds exceed 74 miles (119 kilometers) per hour. By the time a storm reaches hurricane intensity, it usually has a well-developed eye at its center. Surface pressure drops to its lowest in the eye.

In the eyewall, warm air spirals upward, creating the hurricane's strongest winds. The speed of the winds in the eyewall is related to the diameter of the eye. Just as ice skaters spin faster when they pull their arms in, a hurricane's winds blow faster if its eye is small. If the eye widens, the winds decrease.

Heavy rains fall from the eyewall and bands of dense clouds that swirl around the eyewall. These bands, called *rainbands,* can produce more than 2 inches (5



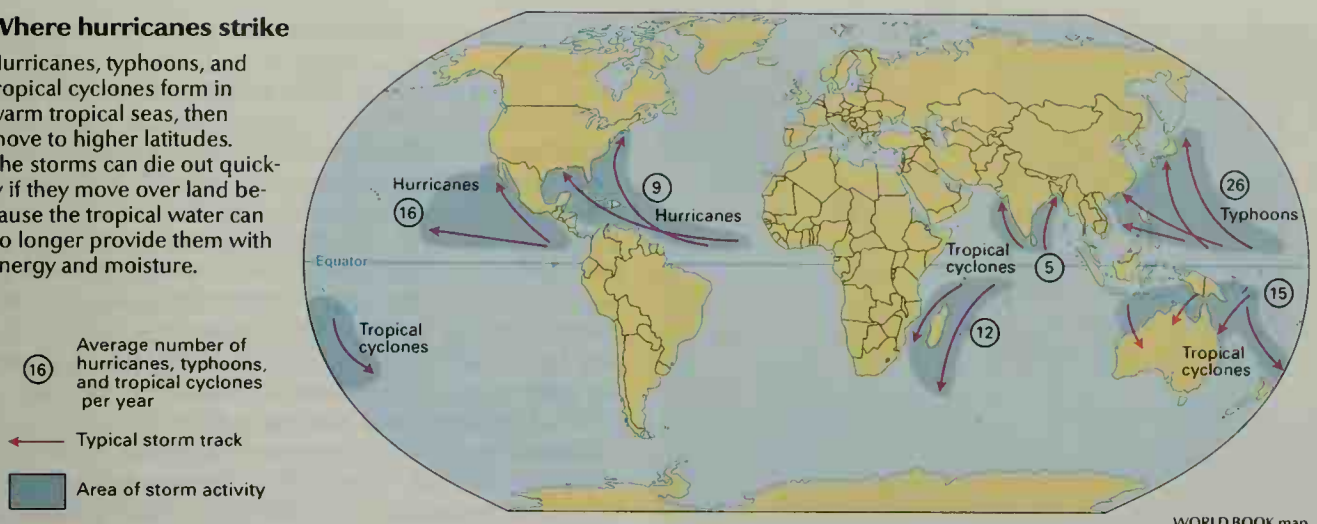
WORLD BOOK illustrations by Bruce Kerr



Hurricane winds on the ocean surface swirl counterclockwise around a calm eye, *left,* in the Northern Hemisphere. Surface winds feed heat energy and water vapor into the storm, *below.* A core of warm air maintains a zone of low pressure near the surface, drawing more air into the hurricane. Much rain falls from tall bands of clouds called the *eyewall* and *rainbands.* The illustration below is not to scale. The cloud structure is about 150 miles (240 kilometers) across and 8 miles (13 kilometers) high.

Where hurricanes strike

Hurricanes, typhoons, and tropical cyclones form in warm tropical seas, then move to higher latitudes. The storms can die out quickly if they move over land because the tropical water can no longer provide them with energy and moisture.



WORLD BOOK map

centimeters) of rain per hour. The hurricane draws large amounts of heat and moisture from the sea.

The path of a hurricane

Hurricanes last an average of 3 to 14 days. A long-lived storm may wander 3,000 to 4,000 miles (4,800 to 6,400 kilometers), typically moving over the sea at speeds of 5 to 20 miles (8 to 32 kilometers) per hour.

Hurricanes in the Northern Hemisphere usually begin by traveling from east to west. As the storms approach the coast of North America or Asia, however, they shift to a more northerly direction. Most hurricanes turn gradually northwest, north, and finally northeast. In the Southern Hemisphere, the storms may travel westward at first and then turn southwest, south, and finally southeast. The path of a hurricane is often difficult to predict.

All hurricanes eventually move toward higher latitudes where there is colder air, less moisture, and greater wind shears. These conditions cause the storm to weaken and die out. A hurricane ends quickly if it moves over land, because it no longer receives heat energy and moisture from warm tropical water. But heavy rains may continue, even after the winds diminish.

Hurricane damage

Hurricane damage results from wind and water. Hurricane winds can uproot trees and tear the roofs off houses. The fierce winds also create danger from flying debris. Heavy rains may cause flooding and mudslides.

The most dangerous effect of a hurricane, however, is a rapid rise in sea level called a *storm surge*. A storm surge is produced when winds drive ocean waters ashore. Storm surges are dangerous because many coastal areas are densely populated and lie only a few feet or meters above sea level. A 1970 cyclone in East Pakistan (now Bangladesh) produced a surge that killed about 266,000 people. A hurricane in Galveston, Texas, in 1900 produced a surge that killed about 6,000 people, the worst natural disaster in United States history.

Hurricane watchers rate the intensity of storms on a scale called the Saffir-Simpson scale, developed by American engineer Herbert S. Saffir and meteorologist Robert H. Simpson. The scale designates five categories of hurricanes, ranging from Category 1, described as weak, to Category 5, which can be devastating. Category 5 hurricanes have included Hurricane Camille, which hit the United States in 1969, and Hurricane Gilbert, which raked the West Indies and Mexico in 1988.

Famous recent hurricanes, typhoons, and cyclones

1900 A hurricane and storm surge killed about 6,000 people in the Galveston, Texas, area.

1928 About 1,800 people died in a hurricane and floods in the Lake Okeechobee area of Florida. The storm also killed 300 people in Puerto Rico.

1938 A hurricane that became known as the New England Hurricane tore through the northeastern United States, killing about 600 people.

1944 A typhoon in the Philippine Sea sank three destroyers and wrecked over 100 aircraft of the U.S. Pacific fleet; 778 lives were lost.

1963 Hurricane Flora killed about 5,000 people in Haiti, over 1,700 in Cuba, and over 400 in the Dominican Republic.

1969 Hurricane Camille killed more than 250 people in seven states from Louisiana to Virginia.

1970 The storm surge from a tropical cyclone drowned about 266,000 people in East Pakistan (now Bangladesh).

1974 Hurricane Fifi struck Honduras, killing about 8,000 people.

1975 Floods caused by Typhoon Nina killed over 100,000 people in China.

1979 Sea-level pressure dropped to a record 870 millibars as Typhoon Tip passed through the Philippine Sea. (Normal sea-level pressure is about 1,013 millibars.)

1980 Tropical Cyclone Hyacinthe looped around Reunion Island in the Indian Ocean, delivering 252 inches of rain in just 15 days.

1988 Hurricane Gilbert, the most intense hurricane ever recorded in the Western Hemisphere, struck the West Indies and Mexico, causing about 300 deaths.

1992 Hurricane Andrew raked the Bahamas, Florida, and Louisiana, killing 54 and causing about $22 billion in damage.

1998 A cyclone devastated the western India province of Gujarat, killing over 2,000 people.

1998 Hurricane Mitch caused billions of dollars of damage and killed over 11,000 in Central America.

1999 About 9,600 people died in a cyclone and floods in the eastern India province of Orissa.

Forecasting hurricanes

Meteorologists use weather balloons, satellites, and radar to watch for areas of rapidly falling pressure that may become hurricanes. Specially equipped airplanes called *hurricane hunters* investigate budding storms.

© Gary Williams, Gamma/Liaison

A storm surge, a rapid rise in sea level, is the most dangerous part of a hurricane. A storm surge occurs when fierce hurricane winds drive a tremendous volume of ocean water ashore.

The Saffir-Simpson hurricane scale

The chart below shows the Saffir-Simpson scale of hurricane intensity. The scale is based on wind speed in miles per hour (mph) and kilometers per hour (kph) and the height of the resulting *storm surge*—that is, how much the sea level rises above normal high tide.

Hurricane category	Wind speed		Storm surge	
	Mph	Kph	Feet	Meters
Category 1 (weak)	74-95	119-153	4-5	1.2-1.5
Category 2 (moderate)	96-110	154-177	6-8	1.8-2.4
Category 3 (strong)	111-130	178-209	9-12	2.7-3.7
Category 4 (very strong)	131-155	210-250	13-18	4.0-5.5
Category 5 (devastating)	156-	251-	19-	5.8-

Effects

Category 1 Minimal damage to trees, shrubbery, and mobile homes.

Category 2 Considerable damage to trees, mobile homes, and piers; some damage to roofs.

Category 3 Trees blown down or stripped of leaves; mobile homes destroyed; some damage to other buildings.

Category 4 Extensive damage to windows, doors, and roofs, especially near shore; possible flooding.

Category 5 Small buildings overturned or blown away; severe structural damage to other buildings.

If conditions are right for a hurricane, the National Weather Service issues a *hurricane watch.* A hurricane watch advises an area that there is a good possibility of a hurricane within 36 hours. If a hurricane watch is issued for your location, check the radio or television often for official bulletins. A *hurricane warning* means that an area is in danger of being struck by a hurricane in 24 hours or less. Keep your radio tuned to a news station after a hurricane warning. If local authorities recommend evacuation, move quickly to a safe area or a designated hurricane shelter. Gary Barnes

See also Cyclone; Safety (During a hurricane); Tornado; Typhoon.

Additional resources

Allaby, Michael. *Hurricanes.* Facts on File, 1997.
Lauber, Patricia. *Hurricanes: Earth's Mightiest Storms.* Scholastic, 1996. Younger readers.

Hurston, Zora Neale (1891?-1960), was an African American writer known for her novels and collections of folklore. Hurston's best-known novel is *Their Eyes Were Watching God* (1937). The story sensitively portrays a young black woman's realization of her identity and independence. Hurston wrote three other novels—*Jonah's Gourd Vine* (1934), *Moses, Man of the Mountain* (1939), and *Seraph on the Suwanee* (1948). All her novels display her interest in Southern black folk customs, her metaphorical language, and her robust sense of humor.

Records suggest Hurston was born on Jan. 7, either in 1891, 1901, or 1903, in Eatonville, Florida, a town founded by African Americans. In 1928, she graduated from Barnard College, where she studied anthropology. Hurston recognized the significance of the folklore of the southern United States and the Carib-bean countries. She collected Florida folk tales and descriptions of Louisiana folk customs in *Mules and Men* (1935). In *Tell My Horse* (1938), she described folk customs of Haiti and Jamaica. A collection of folk tales from the rural South was published in 2001 as *Every Tongue Got to Confess.* Hurston also wrote an autobiography, *Dust Tracks on a Road* (1942). William L. Andrews

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Plant, Deborah G. *Every Tub Must Sit on Its Own Bottom.* Univ. of Ill. Pr., 1995.
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Hurtado, Miguel de la Madrid. See De la Madrid Hurtado, Miguel.

Hus, John (1369?-1415), was a Bohemian religious reformer. His name is also spelled *Huss.* Hus's teachings resembled some of those of the Protestant Reformation. He was burned at the stake on a charge of heresy.

Hus was born in Husinec, in southwestern Bohemia, and took his last name from the first letters of the town. Soon after he was ordained as a Roman Catholic priest in 1400, he began preaching fiery sermons in Prague. He attracted many followers, especially Czech nationalists. Hus attacked the morals of the clergy and called for reform in the church. He was influenced by John Wycliffe, an English religious reformer of the 1300's. Unlike Wycliffe, Hus did not attack the sacrament of the Mass.

In 1409, the king of Bohemia turned the University of Prague over to the Czechs, and Hus became rector. This action angered the German teachers and students at the university. They left and established the University of Leipzig. The Germans spread the story that Hus was a notorious heretic. Because of this story, and his attack on the church practice of selling indulgences to finance crusades, Hus was excommunicated in 1412. In 1413, he completed *On the Church,* a highly spiritualized view of the church that borrowed heavily from Wycliffe's writings. In 1414, Hus was called before the Council of Constance, a meeting of church leaders at Constance, Germany. There he was condemned, largely for the ideas expressed in *On the Church* and for supporting Wycliffe. He was then burned at the stake, even though he had been promised safety if he attended the council to defend himself. Hus's reform movement was carried on

for several years after his death by followers known as Hussites. M. U. Edwards

See also Wycliffe, John.

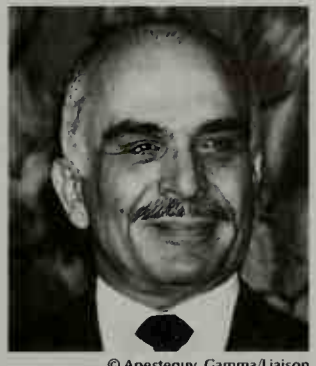
Husky. See Siberian husky.

Huss, John. See Hus, John.

Hussars, *hu ZAHRZ,* were European light cavalrymen armed with carbines, swords, and sometimes pistols. The term came from the Magyar words *husz,* or *twenty,* and *ar,* or *pay.* Every 20th house in a village provided one mounted soldier. The hussars wore bright, colorful uniforms, including a high cylindrical hat called a *busby* and a loose cape called a *dolman.* Hussars, first used by the Magyars in the 1400's, reached their peak of efficiency under Napoleon. They scouted and raided the enemy, and screened the main army. They became obsolete soon after World War I (1914-1918). Richard A. Sauers

Hussein I, *hoo SAYN* (1935-1999), was king of Jordan from 1952 to 1999. He became known for his efforts to achieve peace between Arabs and Israelis in the Middle East. He also developed Jordan's economy.

Hussein was born on Nov. 14, 1935, in Amman. He succeeded his father, Talal, as king in 1953. In 1967, Jordan, Egypt, and Syria were defeated by Israel in a six-day war. Israel occupied part of western Jordan, an area in Palestine called the West Bank. As a result, many West Bank Palestinians fled to eastern Jordan. Eventually, Palestinian guerrillas threatened to overthrow Hussein. His stand against them led to a civil war between Jordanian and Palestinian forces in 1970, which Jordan quickly won. In 1974, Hussein gave up Jordan's authority over the West Bank but still gave financial and administrative support. He stopped this support in 1988.



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Hussein I

In 1990, Iraq invaded Kuwait. Western and Arab nations formed an alliance and drove the Iraqis out of Kuwait in 1991. Hussein was neutral in the conflict. As a result, Jordan's relations with Arab nations in the alliance became strained. In July 1994, Hussein and Israeli Prime Minister Yitzhak Rabin agreed to end a state of war that had technically existed between Jordan and Israel since 1948. The two nations signed a peace treaty in October. Hussein then led efforts to bring peace to the Middle East. Peter Gubser

Hussein, *hoo SAYN,* **Saddam,** *sah DAHM* (1937-), has been president of Iraq since 1979. He is chairman of the Revolutionary Command Council of the Baath Party, which sets government policies. Using Iraq's huge petroleum resources, Hussein supervised a successful development program in the 1970's. This was halted by a war between Iraq and Iran from 1980 until 1988, when a cease-fire was declared. Hussein became known for his ruthless actions. For example, in the 1980's, he used chemical weapons against Kurdish people of Iraq, who were seeking self-government.

In August 1990, Hussein ordered Iraqi forces to invade and occupy Kuwait. He accused Kuwait of violating oil production limits set by the Organization of the Petroleum Exporting Countries (OPEC), thus lowering the price of oil. Hussein announced that his country had annexed Kuwait.

Reuters/Bettmann

Saddam Hussein

Many countries, including the United States, Canada, and several Arab and Western European nations, opposed the invasion and sent forces to the region. These nations formed an allied military coalition. The United Nations Security Council approved the use of military force to remove the Iraqi troops from Kuwait if they did not leave Kuwait. But Hussein refused to withdraw his troops, and war broke out on January 16 U.S. time, which was January 17 in Iraq. The allies launched fighter-bombers against military targets in Iraq and Kuwait, and Iraq launched missiles against Saudi Arabia and Israel. In February, allied land forces moved into Kuwait. They quickly defeated the occupying Iraqi forces. For more details, see **Persian Gulf War.** Hussein's government failed to fulfill the terms of a United Nations cease-fire agreement. The United Nations maintained a trade embargo on Iraq, harming the country's economy (see **Iraq** [Recent developments]).

Hussein was born on April 28, 1937, in Tikrit. He became active in the Baath Party in 1956. In 1959, Hussein left Iraq after he took part in an attempt to kill Iraqi dictator Abdul Karim Kassem. He was imprisoned in 1964, after he returned to Iraq. He had been elected to the Regional Command of the Baath in 1963. In 1965, while in prison, he was elected to the National Command. Hussein escaped from jail in 1966. The Baath took control of Iraq in 1968. During his rise to power, Hussein held important party and government posts. Michel Le Gall

Huston, *HYOO stuhn,* **John** (1906-1987), was an American motion-picture director. Many of his movies focus on the darker side of life. They often project a corrupt world of double-crossing, greedy characters. But they also usually contain good-hearted types who serve as a contrast to such villains. Some of Huston's best films star Humphrey Bogart as a disillusioned hero, notably *The Maltese Falcon* (1941) and *Key Largo* (1948). Bogart also starred in *The Treasure of the Sierra Madre* (1948) and *The African Queen* (1951). Huston won Academy Awards for his directing and for the screenplay of *The Treasure of the Sierra Madre.* His other major motion pictures include *The Asphalt Jungle* (1950), *Prizzi's Honor* (1985), and *The Dead* (1987).

Photofest

John Huston

Huston began work in Hollywood as a screenwriter in the early 1930's. In 1941, he made his directing debut with *The Maltese Falcon.* During World War II, he made several war documentaries, including *The*

Battle of San Pietro (1945) and *Let There Be Light* (1946).

Huston was born in Nevada, Missouri. His father, Walter Huston, and his daughter Anjelica also became noted performers. Gene D. Phillips

Hutchins, Robert Maynard (1899-1977), an American educator, became well known for his unconventional theories about higher education. In 1929, he was appointed president of the University of Chicago. He became chancellor in 1945. At Chicago, he promoted intellectual rather than narrow moral considerations as the primary aim of higher education. He reduced the emphasis on athletics. He served as associate director of the Ford Foundation from 1951 to 1954. Hutchins served as president of the Fund for the Republic from 1954 to 1969 and as chairman from 1969 to 1974.

Hutchins was born in the Brooklyn section of New York City. He graduated from Yale University. In 1928, he became dean of the Yale Law School. Douglas Sloan

See also Chicago, University of; Ford Foundation.

Hutchinson, Anne Marbury (1591-1643), headed a group of Puritans whose religious beliefs were unacceptable to Puritan leaders of the Massachusetts Bay Colony. Her teachings caused deep divisions in the colony between 1636 and 1638.

Anne Marbury was born in Alford, Lincolnshire, England. She married William Hutchinson in 1612. In 1634, the Hutchinson family moved to the Massachusetts Bay Colony. There, Anne joined the congregation in Boston. She began holding religious meetings in her home, where she interpreted church teachings in ways that Puritan leaders considered dangerous. For example, Hutchinson preached that nothing people could do by choice, including obeying church and state law, could win God's love and favor. She also said that God communicated to people directly instead of through public and church officials. She and her followers were called *Antinomians*, meaning people who are against law.

Massachusetts officials ordered Hutchinson to leave the colony in 1637, and the church expelled her in 1638. She moved with her family to Rhode Island, and then to New York after her husband died in 1642. She was murdered there by Indians in 1643. Pauline Maier

Hutchinson, Thomas (1711-1780), was one of the last royal governors of the Massachusetts Bay Colony. His refusal to let the tea ships leave Boston Harbor led to the Boston Tea Party in 1773 (see **Boston Tea Party**). He was just and able, but he became the symbol of royal power to colonists seeking independence.

Hutchinson, born in Boston, was the son of a wealthy merchant. He graduated from Harvard College in 1727 and entered his father's business. He was elected to the Boston board of selectmen and the general court of Massachusetts in 1737, and became chief justice of the colony in 1760. He issued the famous and unpopular writs of assistance (see **Writ of assistance**). He opposed the Stamp Act, but declared it legal and tried to enforce it. In 1765, angry colonists burned his house. He became acting governor in 1769 and governor in 1771.

After the Boston Tea Party, Hutchinson went to England. He advised King George III and continued writing his important *History of the Colony and Province of Massachusetts Bay.* John W. Ifkovic

Hutterites, *HUHT uh ryts,* also called Hutterian Brethren, are members of a religious sect who believe in the common ownership of goods. They follow the example of the early Christians who "had all things common" (Acts 2: 44). They do not believe in war or violence. They live in *Bruderhofs* (colonies) of about 85 persons. There are about 320 Bruderhofs in South Dakota, Montana, Washington, the Eastern United States, the Prairie Provinces of Canada, and England.

The Hutterites are farmers who lead simple lives. They meet daily for worship. A preacher and a *Wirt* (boss), who is the financial manager, head each colony. The group also has its own kindergarten and school.

The Hutterites originated in 1528 in Moravia as a branch of the Anabaptists. They were named for Jacob Hutter, who was their leader from 1533 until 1536 when he was burned at the stake. The Hutterites were severely persecuted. After 1564, they prospered in Moravia. But in 1595, they were driven to nearby countries and to Ukraine. They settled in the United States in 1874. Many migrated to Canada in 1918.

Critically reviewed by Hutterian Brethren

See also **Alberta** (Population); **Anabaptists.**

Hutton, James (1726-1797), a Scottish philosopher and chemist, was a pioneer in the field of geology. His main contributions included the ideas that the earth was immensely old and that its features were constantly and gradually changing. He argued that many such changes were caused by heat within the earth. Hutton discussed this geological change in his book *Theory of the Earth* (1795). His theory that geological forces are the same now as in the past became known as *uniformitarianism.*

According to Hutton, rocks were constantly breaking down into soil. The soil was washed off the continents and carried into the sea by rain and rivers. Then, heat from under the earth's surface consolidated the soil into new layers of rock and eventually elevated the rock above sea level. This process led to the creation of new continents, which replaced those that had been worn away. Many thinkers of Hutton's day accepted Biblical evidence that the earth was about 6,000 years old. Hutton thought that this figure was much too low. Most theorists also believed that only rare disasters, such as earthquakes, could change the earth's appearance.

Hutton was born in Edinburgh. He studied medicine there but received his degree from Leiden University in the Netherlands. After becoming a farmer in Scotland, he became interested in geology. Dennis R. Dean

See **Geology** (History [The rock dispute; Experimental geology]).

Hutu, *HOO too,* is the name of a group of black African people. They are sometimes called Bahutu. Most of the approximately 15 million Hutu live in the central African nations of Burundi and Rwanda. They speak a Bantu language. Most Hutu are Christians, but many also follow traditional African beliefs.

Ancestors of the Hutu came to their present lands from other parts of Africa sometime during the first several hundred years after the time of Christ. They brought with them iron tools, a distinctive style of pottery, and a number of domesticated crops.

Most Hutu are farmers and live in the more fertile areas of their region. But they can barely raise enough food to feed their families, partly because Burundi and Rwanda are among the most densely populated countries in Africa.

In the A.D. 1300's or 1400's, Tutsi people (also called Batutsi or Watusi) came to the area from northeastern Africa. The Tutsi were a minority, but they gradually became the dominant group economically and politically. This situation has led to many years of violent ethnic clashes. In the 1990's, fighting between the Hutu and Tutsi killed hundreds of thousands of people in Burundi, Rwanda, and Congo (Kinshasa). John W. Burton

See also **Burundi; Ruanda-Urundi; Rwanda; Tutsi.**

Huxley, Aldous (1894-1963), an English writer, had one of the most varied literary careers of his time. He published three collections of poems and a book of stories before starting the series of witty, sophisticated novels that made him famous. The series includes *Crome Yellow* (1921), *Antic Hay* (1923), *Those Barren Leaves* (1925), and *Point Counter Point* (1928). The books satirize English society. *Point Counter Point*'s characters are based on Huxley and his friends.

Huxley believed that science was destroying human and political values. He expressed this concern in the satirical novel *Brave New World* (1932). This famous book describes a totalitarian society that disregards individual dignity and worships science and machines.

Aldous Leonard Huxley was born in Godalming, in the county of Surrey. Huxley moved to the United States during the late 1930's, and he spent most of the rest of his life there. Huxley was the grandson of the famous zoologist Thomas Henry Huxley and the brother of the noted biologist Sir Julian Huxley. Garrett Stewart

Huxley, Sir Julian Sorell (1887-1975), was a noted British biologist. He did research in *ornithology* (the study of birds) and on the experimental analysis of development. He made a study of the relative rates of growth of bodily organs and developed a mathematical method to analyze body proportions. His book *Evolution, the Modern Synthesis* (1942) unites theories of evolution with modern theories of genetic inheritance.

In 1946, Huxley helped establish the United Nations Educational, Scientific and Cultural Organization, which became better known as UNESCO. He was elected the agency's first director-general in 1946. In 1958, he was knighted for his contributions to science.

Huxley's writings include *Essays of a Biologist* (1923), *The Science of Life* (with H. G. Wells and G. P. Wells, 1929-1930), *Problems of Relative Growth* (1932), *Elements of Experimental Embryology* (with G. R. de Beer, 1934), *Man Stands Alone* (1941), *Man in the Modern World* (1947), and *Essays of a Humanist* (with H. B. Kettlewell, 1964). He also wrote several poems.

Huxley was born in London. He taught at Rice Institute in Texas from 1912 to 1916. He later became a professor at King's College, London. Huxley was a grandson of British scientist Thomas Henry Huxley. Keith R. Benson

Huxley, Thomas Henry (1825-1895), was a famous British zoologist, lecturer, and writer. He was one of the first scientists to accept Charles Darwin's analysis of organic evolution, and he extended and defended it (see **Darwin, Charles R.**). Through lectures, writings, and public service, he helped advance scientific thought.

Huxley's writings include *Evidence as to Man's Place in Nature* (1863) and *A Manual of the Anatomy of Invertebrated Animals* (1877). His essay "On a Piece of Chalk" (1868) and his essay about changes in the limbs and teeth of fossil horses are outstanding presentations in support of evolution. Many of Huxley's expressions became famous. He introduced the word *agnostic* to describe one who rejects any conclusion that cannot be clearly demonstrated, including beliefs in the existence of God or a spiritual world. He coined the word *biogenesis* to emphasize that life arises only from previous life (see **Biogenesis**).

Huxley was born near London, and he studied by himself until he entered medical school. He became a surgeon in the British navy and spent four years in the Indian Ocean and East Indies. During these years, Huxley wrote a pioneering account of jellyfishes, and he returned to England in 1850 to find that he had become famous. Huxley taught natural history at the Government School of Mines (later the Royal School of Mines) beginning in 1854. He was president of the Royal Society from 1881 to 1885. Keith R. Benson

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Huygens, *HY guhnz,* **Christiaan** (1629-1695), was a Dutch physicist, astronomer, and mathematician. In 1678, Huygens proposed that light consists of series of waves. He used this theory in investigating the *refraction* (bending) of light.

Huygens' wave theory competed for many years with the *corpuscular theory* of the English scientist Isaac Newton. Newton maintained that light is made up of particles. Today, scientists believe that light behaves as both a particle and a wave.

Huygens was born in The Hague, the Netherlands. He studied mathematics and law at the University of Leiden and the College of Orange at Breda. Huygens worked with his brother Constantijn to develop skill in grinding and polishing spherical lenses. With these lenses, they built the most powerful telescopes of their time. Huygens also discovered a satellite of Saturn and asserted that what astronomers called "Saturn's arms" was a ring. In mathematics, he refined the value of *pi* (see **Pi**). In the 1650's, Huygens invented a clock with a freely suspended pendulum. Ronald S. Calinger

See also **Light** (Early ideas about light).

Hyacinth, *HY uh sihnth,* is a favorite spring flower of the lily family. It originated in the Mediterranean region and *Asia Minor* (now Turkey), and was brought to western Europe in the early 1500's. It is a popular plant. The bell-shaped flowers of blue, pink, white, yellow, or purple bloom from February to April on stalks 8 to 15 inches (20 to 38 centimeters) high.

Hyacinths grow from bulbs. They can be planted in open beds, greenhouses, and in the home. When raised in the open, they need rich, well-drained soil. The bulbs are planted from September to November, depending on the climate. Early in the spring, the flowers appear. Gardeners sometimes tie the stems of hyacinths to slender stakes to protect them. After the plant flowers, gardeners remove the stalks and let the leaves die. This encourages new bulb growth. Florists pot specially treated bulbs early in September to force the plants to blossom by Christmas.

The soil and climate of the Netherlands provide an es-

WORLD BOOK illustration by Robert Hynes

The hyacinth is a spring flower that grows from a bulb. It produces small, fragrant, bell-shaped flowers on a slender stalk.

pecially favorable place for growing the bulbs. The Dutch plant a large number of hyacinths every year near Haarlem. They ship these bulbs to many parts of the world for gardeners and florists to use.

August A. De Hertogh

Scientific classification. The hyacinth belongs to the lily family, Liliaceae. Its scientific name is *Hyacinthus orientalis.*

See also **Bulb; Flower** (picture: Garden perennials [Bulbs]).

Hyaline membrane disease, *HY uh lihn,* or *respiratory distress syndrome,* is a lung condition that affects premature babies. Such babies are born before the end of a normal nine-month pregnancy. The disease is related to the underdevelopment of the lungs of these infants. The air sacs of the lungs collapse, causing rapid, difficult breathing and, in many cases, death by suffocation. Hyaline membrane disease ranks as a major cause of death among premature infants. It attacks few babies born after a nine-month pregnancy.

The term *hyaline membrane* refers to the clear, glassy membranes found in the lungs of babies that die of the disease. Many physicians believe these membranes are produced as a reaction to lung damage caused by the strain of breathing air in an immature lung.

A victim of the disease has difficulty breathing within minutes after birth. Underdeveloped lungs lack a substance called *pulmonary surfactant.* This substance prevents the air sacs from collapsing. The intensive care units in many hospitals include respirators and high-humidity incubators for treating hyaline membrane victims. Such treatment keeps many babies alive long enough for their lungs to become sufficiently developed to produce pulmonary surfactant. This development takes four to five days in most cases, but it may require several weeks. Most infants who recover have no permanent aftereffects. Scientists have developed artificial surfactants that can be given to infants soon after birth to prevent the disease.

In the early 1970's, doctors discovered a way to determine whether an unborn baby's lungs lack pulmonary surfactant. With this knowledge, a physician may try to delay a premature birth until the lungs have developed sufficiently. If a premature birth is not delayed, a physician can give the mother a synthetic hormone to accelerate lung development in the fetus.

Mary Ellen Avery

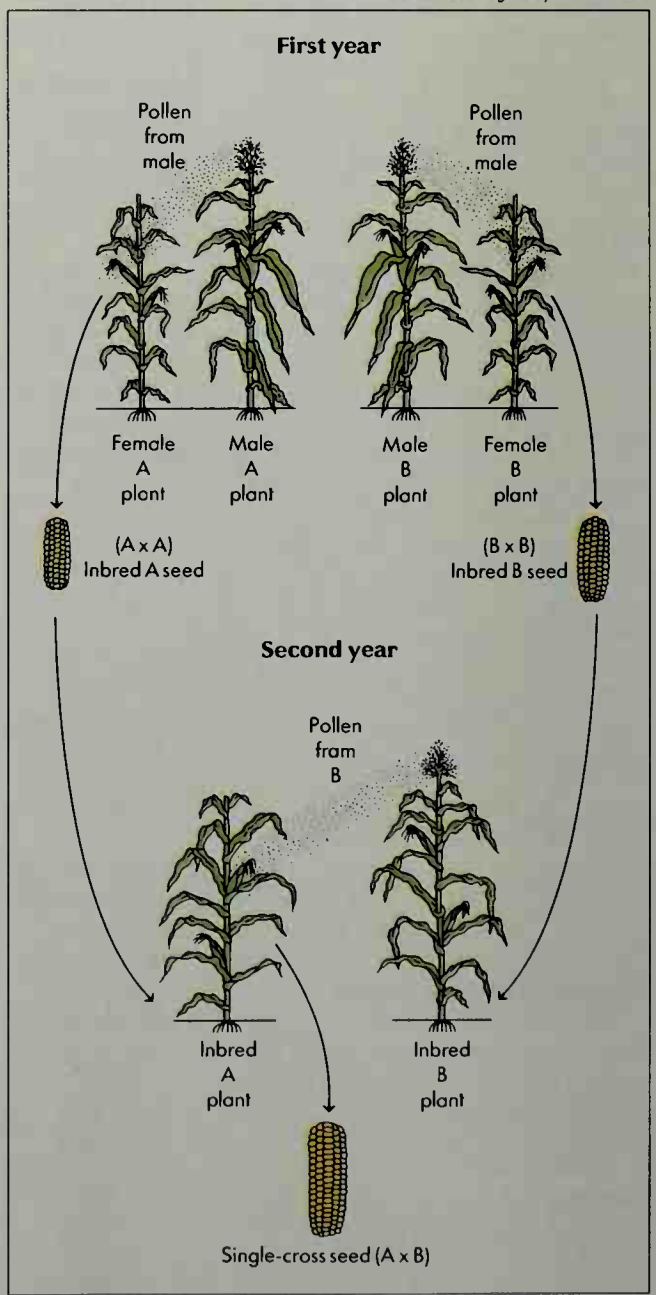
Hybrid is the offspring of parents of different breeds, varieties, or species. Hybrids occur naturally and contribute to the great variety of living things. However, the term *hybrid* is used most often to refer to crops and ornamental plants bred by human beings.

Hybrid plants rank among the most important agricultural products. Most commercial varieties of corn, sorghum, sugar beets, and burley tobacco are hybrids,

Producing hybrid corn

Most hybrid corn results from *single crossing.* In this process, selected corn plants are forced to breed with other plants of the same variety. This procedure produces *inbred seed.* Two inbred varieties are then bred, resulting in single-cross seed.

WORLD BOOK diagram by Zorica Dabich



as are some varieties of alfalfa, barley, rice, and wheat. Vegetables produced from hybrid seed include broccoli, carrots, cauliflower, onions, pumpkins, and tomatoes. Hybrids of such fruits as grapes, pears, and plums are also grown. Many marigolds, orchids, roses, and other flowers that beautify homes and parks are hybrids.

Hybrid animals have also become important in agriculture. People commonly produce hybrid livestock by mating different breeds. Such hybrids are called *crossbreds.* Cattle crossbreds rank among the most common animal hybrids worldwide. In the United States, most chickens, hogs, and turkeys, as well as many beef cattle, are crossbreds.

People develop crossbreds to produce animals with desirable traits. For example, crossbred cattle can yield leaner, better quality meat than do other cattle. Hybrid plants are developed to improve the quality and productivity of cultivated plants. The following section deals with how people produce such plants.

Producing hybrid plants. Plants selected for hybrid production have hereditary characteristics that growers want to continue into future generations. For example, one variety of corn may resist disease better than another variety does. But the second variety may be hardier in cold weather than the first. By *crossing* (mating) the two varieties, growers can obtain hybrid seeds. These seeds develop into plants that have the traits of both parents. Seeds from hybrid offspring, however, produce plants of varying quality. As a result, growers plant new hybrid seed each year to maintain the quality of their crops.

Most flowering plants have both male and female sex parts, contained either in separate flowers or in the same flower. To ensure that only certain plants cross, growers select some to serve as males and some as females. They generally remove the male sex parts, which produce pollen, from the plants that will act as females, thereby preventing the plants from pollinating themselves or other females. In some cases, they use female plants that have been specially bred to produce infertile pollen. The male plants are untouched.

The hybrid seed produced from the crossing of selected parents is often the result of a long and complicated process. Corn growers, for example, first cause selected corn plants of the same variety to breed. This procedure is called *inbreeding.* The seeds produced from the inbred plants are planted, and the plants that grow from them are in turn forced to inbreed. This process continues through several generations until plants having pure hereditary lines are established.

Growers then cross two inbred varieties. They remove the *tassels* (male corn flowers) from the plants chosen as females, leaving the *ears* (female corn flowers) for pollination by the males. Seed resulting from this breeding produces *single-cross hybrids.* These plants combine the hereditary characteristics of two inbred varieties.

History. People have produced such hybrids as mules for centuries. Mules result from the mating of a male donkey with a female horse. Many different kinds of hybrid plants were described by naturalists during the 1700's and 1800's. In 1922, hybrid seed corn was sold to farmers in the United States for the first time. By the mid-1940's, nearly all corn planted in the major U.S. corn-growing areas was hybrid corn. Hybrids became important for other kinds of crops during the 1960's. At the end of the 1900's, most vegetables and many kinds of livestock were hybrids. Ben T. McDaniel

See also **Breeding** and its list of *Related articles.*

Hyderabad, *HY duhr uh BAD* (pop. 3,449,878; met. area pop. 5,533,640), is one of India's largest cities. Founded in 1589 as a royal capital, it became the capital of the state of Hyderabad in 1950 and the capital of Andhra Pradesh in 1956. For the location of Hyderabad, see **India** (political map).

Hyderabad has many palaces and the *Char Minar,* built in 1591. This building has four *minarets* (towers) and four arches through which the main streets of the city pass. Hyderabad is a trading hub and manufactures textiles, guns, glassware, paper, flour, and railway cars. It is the home of Osmania University. Robert LaPorte, Jr.

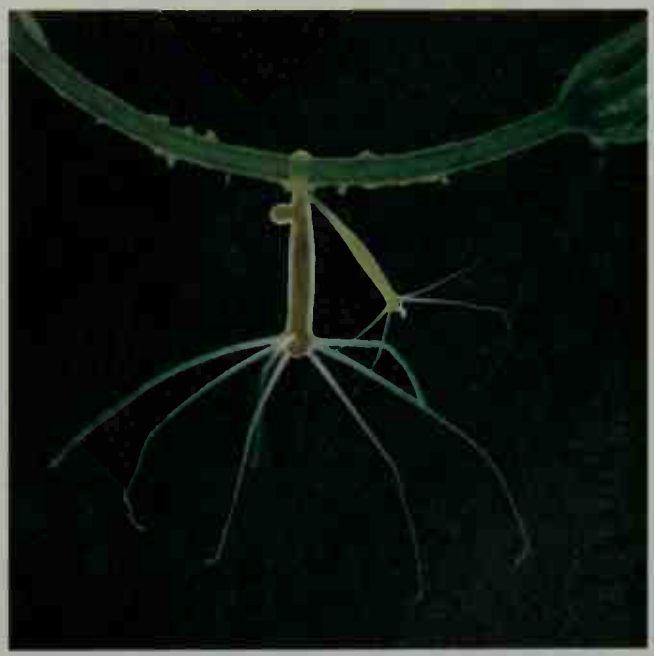
Hydra, *HY druh,* was a many-headed serpent of Greek mythology. It is called the *Lernaean Hydra* or the *Hydra of Lerna* because it lived in Lake Lerna in Argolis. One of the hydra's heads could not die, and the rest grew back as soon as they were cut off. But Hercules and his nephew Iolaus killed the monster by first cutting off all the heads except the immortal one and sealing each neck with fire. Hercules then cut off the immortal head of the hydra and buried it under a rock. Mary R. Lefkowitz

See also **Hercules** (The twelve labors).

Hydra, *HY druh,* is a tiny, slender animal that lives in ponds and lakes. Hydras are *cnidarians,* a group that also includes jellyfish, sea anemones, and corals.

The hydra has one of the simplest structures of the many-celled animals. It is shaped like a thin cylinder about as thick as heavy thread and is about $\frac{1}{4}$ to $\frac{1}{2}$ inch (6 to 13 millimeters) long. A hydra may be gray, tan, brown, or green. The green hydra gets its color from algae that live in certain cells of its body wall.

One end of a hydra's body attaches to sticks, stones, and water plants. The other end contains the mouth, which is surrounded by five to seven *tentacles* (tiny



Kim Taylor, Bruce Coleman Ltd.

The hydra usually begins life as a bud that grows on the body of its parent, as shown here. When fully developed, the young hydra detaches itself and lives independently.

arms). The hydra can stretch out or contract its entire body. Sometimes it stretches its tentacles until they look like long, delicate threads. At other times, it pulls in its tentacles. Then its body looks like a tiny egg with a group of knobs on the end. The hydra usually stays attached in one place for some time. But it can move about by slowly somersaulting on the bottom of the pond or lake, or by drifting upside down beneath the water's surface film.

A hydra eats other small water animals that it captures with its tentacles. Each tentacle has tiny cells that contain stinging threads. The hydra drives these threads into its prey, and they give off a poison that paralyzes the victim. Then the tentacles draw the victim into the mouth to be swallowed. The hydra's mouth is a small opening leading directly into a large digestive cavity inside the body. The undigested remains pass out through the mouth.

Hydras usually reproduce by *budding. Buds* are small, knoblike growths that appear on the body of the hydra from time to time. As the buds develop, they grow tentacles. When the buds are fully developed, they break off and live as independent hydras. Hydras also may produce eggs and sperm in the body wall. An egg unites with a sperm, grows larger, and eventually separates from the parent and drops into the water. A tough outer capsule protects the egg from damage, freezing, or drying out. After a while, a small hydra hatches.

Hydras can *regenerate* (regrow) parts of their bodies. It is estimated that in a period of several weeks a hydra replaces all the cells in its body. The hydra, therefore, never grows old.

Scientific classification. Hydras belong to the phylum Cnidaria and the class Hydrozoa. L. Muscatine

Hydrangea, *hy DRAYN juh,* is the name of about 23 species of handsome shrubs. Hydrangeas are native to North and South America, China, and Japan. They may be *deciduous,* which means they lose their leaves each autumn, or evergreen. The *peegee hydrangea* grows to 30 feet (9 meters) high. The *climbing hydrangea* is considered one of the best clinging vines for landscaping.

Hydrangeas bear white, pink, or bluish flowers. Each small flower grows with many others in large, showy clusters. Hydrangeas need rich and slightly moist soil. They grow well in partly shaded places. They flower more freely in the sun if they have sufficient moisture. Hydrangeas are grown from cuttings or seeds. They bloom from late summer until fall.

Scientific classification. Hydrangeas belong to the saxifrage family, Saxifragaceae. The peegee hydrangea is *Hydrangea paniculata,* variety Grandiflora. The climbing hydrangea is *H. anomala.* Fred T. Davies, Jr.

WORLD BOOK illustration by Robert Hynes

The hydrangea is an attractive shrub that produces small flowers that grow in clusters. The *peegee hydrangea, above,* may grow to a height of 30 feet (9 meters).

See also **Flower** (picture: Garden perennials [Flowering shrubs]).

Hydrate, *HY drayt,* is a chemical compound made of a definite amount of water and another substance. For example, the hydrate *blue vitriol* (copper sulfate pentahydrate) is formed by the combination of a copper atom, a sulfur atom, and four oxygen atoms with five water molecules. Its chemical formula is $CuSO_4 \cdot 5H_2O$. When the water in a solution of copper sulfate evaporates, the blue vitriol crystals that form are dry. But they retain a certain amount of water. This water is called *water of crystallization* or *water of hydration.*

In many cases, the water of hydration is driven off by heating the hydrate. The compound then becomes *dehydrated.* When all the water is gone, the compound becomes *anhydrous.* Anhydrous salts often differ from their hydrates in color and crystal form. The blue crystals of blue vitriol change into a white powder when the compound becomes anhydrous. Anhydrous copper sulfate has the formula $CuSO_4$.

Some hydrates, such as *washing soda* (sodium carbonate decahydrate, $Na_2CO_3 \cdot 10H_2O$), spontaneously lose their water of hydration when exposed to the air at room temperature. These compounds are called *efflorescent.* Their crystals slowly turn into a powder as they lose water. Efflorescence takes place faster when the humidity is low. Peter A. Rock

Hydraulic brake. See **Brake.**

Hydraulic engine, *hy DRAW lihk,* or *fluidic engine,* is a machine that produces motion by means of pressure from water or some other fluid. This type of engine can be used to drive machinery or move heavy loads. Examples of hydraulic engines include jacks, hoists, the power steering and brake mechanisms of automobiles, and the control systems of aircraft.

There are two basic types of hydraulic engines—*reciprocating engines,* such as hydraulic elevators and suction pumps; and *turbines,* such as those that turn electric generators. Reciprocating engines operate at slow speeds. Turbines usually function at higher speeds.

Early hydraulic engines used water to produce power. Today, engines that use water are rare except for water turbines in hydroelectric plants. Modern hydraulic engines use fluids that do not freeze at low temperatures. Such fluids include oil, certain silicones, and some gases. The fluid in some hydraulic engines is put under pressure mechanically. In other engines, the pressure comes from the weight of the fluid stored in a reservoir above the engine. Roger E. A. Arndt

See also **Hydraulics; Locomotive** (Diesel locomotives); **Pump** (Reciprocating pumps); **Turbine** (Water turbines).

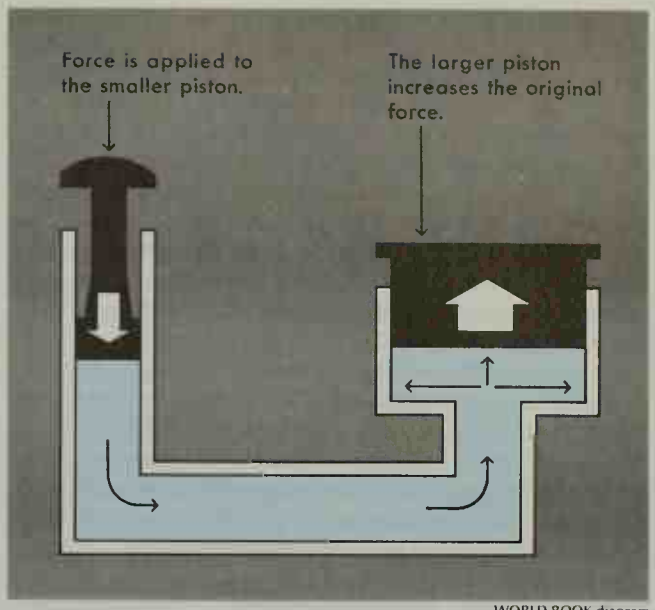
Hydraulics, *hy DRAW lihks,* is the branch of physics that studies the behavior of liquids at rest and in motion. Some laws of hydraulics apply to both gases and liquids. But they apply only under certain conditions, such as when gases flow at low velocity and are not compressed. Scientists sometimes divide the study of hydraulics into two categories—*hydrostatics* and *hydrodynamics.* Hydrostatics describes the behavior of liquids at rest. Hydrodynamics describes their behavior in motion.

Hydraulics is studied and applied in two of the specialty fields of engineering: civil engineering and mechanical engineering. Civil engineers use the principles of hydraulics mainly to study the flow of water in open or partially filled pipes. They design embankments and levees that provide flood control along rivers, as well as canals, irrigation systems, and sewage systems. They also plan water supply systems for cities and towns.

Mechanical engineers are usually more concerned with the flow of fluids in filled pipes under pressure. They use the principles of hydraulics to design *hydraulic machines.* These machines include hydraulic turbines, hydraulic brakes, power steering for cars, controls for airplanes and spacecraft, and construction equipment.

Pressure from water or some other fluid supplies the power that runs hydraulic machines. Some hydraulic machines, including turbines, operate by the force of a flowing fluid. Turbines are large wheels that change the potential energy of a fluid into work that can be used to power an electric generator or perform some other type of work. Steam or gas powers other kinds of turbines.

Other hydraulic machines, called *hydraulic presses,* increase and transfer force through a fluid from one piston to a larger piston. Industry uses hydraulic presses for such jobs as lifting heavy loads and pressing metal parts. One form of hydraulic press is called a *hydraulic jack.*



WORLD BOOK diagram

A hydraulic press increases and transfers the force applied to one piston through a liquid to a larger piston. The force increases in direct proportion to the ratio of the area of the larger piston to the area of the smaller piston. Industry uses hydraulic presses to lift heavy loads.

Liquids at rest

Use of hydrostatic principles is fundamental to the design of many machines and instruments. The design of hydraulic presses and the operation of such instruments as manometers and barometers depend on laws of hydrostatics.

A simple hydraulic press consists of a cylinder that contains two pistons, one smaller than the other. The cylinder is filled with a fluid. A force applied to the smaller piston is transferred through the fluid to the larger piston. The force increases in direct proportion to the ratio of the area of the larger piston to the area of the smaller piston. Automobile brakes operate on the principle of the hydraulic press. Pressure applied to the brake pedal is transmitted through a liquid to brake shoes, which press against the car's wheels.

A *manometer* measures the pressure exerted by a liquid or a gas. The simplest kind of manometer is a U-shaped tube with open ends. The tube contains a liquid, usually mercury or water, which fills the bottom of the U and rises a short distance in each arm. The liquid in the manometer must have a different weight per unit of volume than the substance whose pressure is to be measured. One arm is connected to the place where the pressure is to be measured. The other arm remains open to the atmosphere. The difference in liquid level in the arms indicates the pressure compared to atmospheric pressure. See **Manometer.**

A *barometer* measures atmospheric pressure. It is used primarily to forecast weather and to measure heights of mountains. One type of barometer consists basically of a tube containing mercury. At sea level, a column of mercury about 30 inches (76 centimeters) high equals in weight the force of atmospheric pressure on that column. The level of mercury in the tube rises or falls as the atmospheric pressure changes. See **Barometer.**

Laws of hydrostatics describe the behavior of liquids at rest.

One principle of hydrostatics states: *The pressure caused by the weight of a column of fluid is determined by the height of the column.* The shape of the column does not affect the pressure that is exerted by the fluid.

Suppose that a pipe extends in a zigzag pattern from the ceiling to the floor. Another pipe of equal diameter extends straight down from the ceiling to the floor. The second pipe is, of course, shorter than the first. If both pipes are filled with water, the longer one will hold more water. But the water pressure at the bottom of both pipes will be equal because the height of both columns of water is equal.

An illustration of the above principle is the buoyant force exerted by a fluid on an object submerged in it. The bottom of an object submerged in water is deeper than the top of the object. Therefore, the column of water pressing on the bottom of the object is taller than the column pressing on the top of the object. Thus, the water exerts an upward force on the object, called a *buoyant force.* Buoyant forces act to keep boats afloat.

Archimedes' principle comes from the principle discussed above. It states: *An object placed in a fluid seems to lose an amount of weight equal to the weight of the fluid it displaces.* A buoyant force exerted on the object by the fluid causes the apparent loss of weight. Archi-

medes, a Greek mathematician, developed this principle during the 200's B.C.

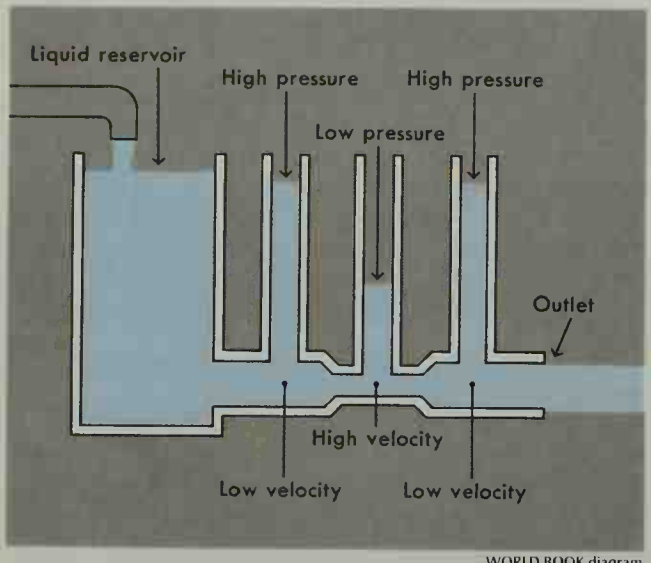
To illustrate this principle, imagine that a 1-liter metal can is placed in water. If the can weighs 3 kilograms, it will displace 1 liter of water, which weighs 1 kilogram. Thus, the buoyant force equals 1 kilogram. The can will then seem to weigh only 2 kilograms—that is, 1 kilogram less than its original weight.

Pascal's law states: *A fluid in a container transmits pressure equally in all directions.* Blaise Pascal, a French scientist and mathematician, developed this law during the A.D. 1600's.

To illustrate Pascal's law, take a bottle with a neck opening of 1 square inch and fill it with water. Put a plug in the neck so that the plug seals the top of the bottle and moves freely in the neck. Place a 1 pound weight on the plug. The pressure of the water will increase by 1 pound over each square inch (1 pound per square inch, or 1 *psi*) of the inside surface of the bottle.

Liquids in motion

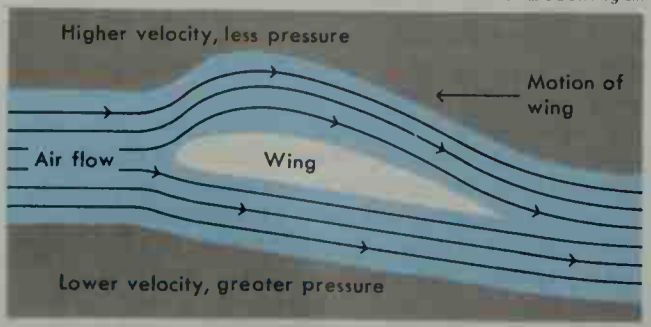
Use of hydrodynamic principles is basic to hydraulic engineering and to the design of certain machines. Engineers use hydrodynamics when planning water supply systems, canals, and irrigation systems. They also apply hydrodynamic principles to the design of airplanes and to the construction of certain hydraulic machines, such as water turbines.



WORLD BOOK diagram

Bernoulli's principle describes both the flow of water through a pipe and the flow of air around an airplane wing. The velocity of flowing water, *above,* increases in the narrow section of pipe. The increased velocity produces less pressure, as indicated by the lower water level in the center vertical pipe. *Below,* air flows faster over the curved surface of a wing than over the flat surface. The increased velocity reduces the air pressure, and the greater pressure under the wing causes the airplane to rise.

WORLD BOOK diagram



Engineers consider many factors to determine the proper pressure for a water supply system. For instance, the height of the reservoir or tank affects the pressure in water flow from the reservoir, and this pressure determines the flow rates that can be obtained. Most reservoirs have a long series of pipes that connects the source of water with its destination. Such factors as pipe size and the friction between the water and the pipes affect the flow of water.

Laws of hydrodynamics play a fundamental role in the design of water turbines. Some water turbines are submerged in rivers, and the normal flow of water provides power. Other water turbines are located at the bases of dams. Water pressure created by the dam is used to speed up the water when it enters the turbine. The turbines then change the kinetic energy of the moving water into rotational energy, which turns generators that produce electricity.

Laws of hydrodynamics describe the behavior of flowing fluids. Fluid flow may be steady or unsteady. An unsteady flow results from changes in the velocity, temperature, or pressure of a fluid. The movement of a fluid around obstructions may also cause an unsteady flow.

There are three basic laws of hydrodynamics. All of them apply only to steadily flowing liquids.

The principle of continuity in fluid flow states: *The velocity of a fluid flowing through a pipe increases as the area of the pipe decreases, and decreases as the pipe's area increases.*

The nozzle of a garden hose uses the principle of continuity. The nozzle decreases the size of the opening at the end of the hose. As a result, water flows faster through the nozzle than through the hose.

Bernoulli's principle, also called *Bernoulli's law,* states: *The pressure of a fluid increases as its velocity decreases, and decreases as the fluid's velocity increases.* Daniel Bernoulli, a Swiss mathematician, developed this principle during the 1700's.

Bernoulli's principle is used in the design of airplane wings. Engineers curve the upper surface of the wing so air will flow faster over the top than it does over the bottom of the wing. The faster-flowing air exerts less pressure on the top of the wing. As a result, the greater pressure under the wing lifts the airplane.

Torricelli's law states: *The velocity with which a liquid flows through an opening in a container equals the velocity of a body falling from the surface of the liquid to the opening.* Evangelista Torricelli, an Italian physicist, developed this law during the 1600's.

According to Torricelli's law, a stream of water flowing through a hole 10 feet (3 meters) below the water surface in a dam has the same velocity as a stone falling that 10-foot distance. Torricelli's law does not apply to gases because a gas has no surface. The velocity at which a gas flows from a container depends on the pressure under which the gas is confined in the container.

James O. Chalupnik

Related articles in *World Book* include:

Archimedes	Hydraulic engine	Turbine
Bernoulli's principle	Pascal, Blaise	Water power
Brake	Pump	

Additional resources

Brater, Ernest F., and others. *Handbook of Hydraulics for the Solution of Hydraulic Engineering Problems.* 7th ed. McGraw, 1996.

Kiselev, Sergei P., and others. *Foundations of Fluid Mechanics with Applications.* 2nd ed. Birkhauser, 1999.

Mott, Robert L. *Applied Fluid Mechanics.* 5th ed. Prentice Hall, 2000.

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Hydrazine, *HY druh zeen,* is an important chemical compound used in jet and rocket fuels. Industry also uses it to make agricultural and textile chemicals, drugs, explosives, photographic developers, and blowing agents used in the manufacture of foam rubber. Hydrazine is also used to prevent rusting in boilers and nuclear reactors. Its derivatives are used to regulate the growth of plants, such as grass on parkways. These chemicals keep the grass from growing so fast that it needs constant attention.

Hydrazine occurs as a colorless, fuming, corrosive liquid. This is a nitrogen-containing base and a powerful reducing agent (see **Base**). It mixes readily with water and alcohol. Hydrazine boils at 114 °C (237 °F) and its chemical formula is H_2NNH_2. It burns readily in air, giving off a great amount of heat, to form nitrogen gas and water. Industry prepares it by various methods from hydrazine hydrate, $H_2NNH_2 \cdot H_2O$. Marianna A. Busch

Hydrocarbon, *HY droh KAHR buhn,* refers to the most important class of organic compounds. Hydrocarbons contain only the elements hydrogen and carbon. They occur in petroleum and natural gas. Commercial petroleum products, such as gasoline, kerosene, airplane fuel, lubricating oils, and paraffin, are mixtures of hydrocarbons. Some hydrocarbons are found in coal tar and coal gas. Many others are *synthesized* (made artificially) from hydrocarbons found in nature.

Hydrocarbons are starting materials for the petrochemical industry. Petrochemical companies use hydrocarbons from crude oil and natural gas to manufacture solvents, plastics, and synthetic fibers and rubbers.

Organic chemistry is sometimes called the "chemistry of hydrocarbons and their derivatives," because all organic compounds are essentially related to the hydrocarbons. Hydrocarbons can be divided into three large classes. These classes are: (1) aliphatics, (2) alicyclics, and (3) aromatics.

Aliphatic hydrocarbons have the principal carbon atoms arranged in chains. They are further divided into the paraffin, olefin, and acetylenic series.

Paraffins, or *alkanes,* include the greatest number of hydrocarbon compounds. They have the general formula C_nH_{2n+2}. Methane, CH_4, is the first member of the series. Others are formed by adding CH_2 groups to methane. For example, ethane is C_2H_6, and propane is C_3H_8. Paraffins react by *substitution.* Hydrogen atoms are replaced by other atoms or groups of atoms, such as halogens or hydroxyls.

Olefins, or *alkenes,* have at least one double bond between two carbon atoms. They have the general formula C_nH_{2n}. Ethylene, C_2H_4, is the first member. Olefins react primarily by *addition* of molecules such as water, oxygen, and halogens. They can also react with themselves to form *polymers* (large chain molecules) such as polyethylene, which is used in plastics.

Acetylenes, or *alkynes,* have at least one triple bond between two carbon atoms. They have the general formula C_nH_{2n-2}. Acetylene, C_2H_2, is the first and most important member of the series. Acetylenic hydrocarbons have reactions similar to the olefins.

Alicyclics have their carbon atoms arranged in a ring. These atoms may have single or double bonds between them. Triple bonds in alicyclics are rare, but they can occur in sufficiently large rings. Many naturally occurring organic compounds fall into this class. The reactions of alicyclics are similar to those of the aliphatics.

Aromatics are a small but highly important class of hydrocarbons. They are characterized by a six-carbon ring. This ring differs from the alicyclics in that it contains three double bonds. *Benzene,* C_6H_6, is the most important aromatic. Others in the benzene series include toluene, $C_6H_5CH_3$, and the xylenes, $C_6H_4(CH_3)_2$. Other aromatic series include the *naphthalenes,* $C_{10}H_8$, and the *anthracenes,* $C_{14}H_{10}$. Robert C. Gadwood

Related articles in *World Book* include:

Acetylene
Benzene
Carbon
Coal tar
Coke oven gas
Damp
Ethane
Ethylene
Methane
Natural gas liquids
Paraffin
Petroleum
Smog (Photochemical smog)
Toluene

Hydrochloric acid is a dangerous chemical that has many important industrial uses. The acid is a colorless liquid with an irritating odor. It fumes when exposed to air. It is highly corrosive and can cause serious burns.

Hydrochloric acid is also called *muriatic acid.* Its chemical formula is HCl. The acid is made by dissolving hydrogen chloride gas in water. The hydrogen chloride gas itself is prepared by burning hydrogen and chlorine gases together or by treating common table salt, sodium chloride, with sulfuric acid. Hydrochloric acid is most commonly sold as a 30 percent solution, called concentrated hydrochloric acid. Neutralization of the acid forms salts called *chlorides.*

Industry uses hydrochloric acid in preparing many chemical compounds. The acid is also used in metallurgy and food processing. In most people, the stomach secretes small amounts of hydrochloric acid, which aids in digestion. However, excess production of the acid by the stomach contributes to the formation of stomach ulcers. Carolyn J. Smith

See also **Acid; Aqua regia; Chloride.**

Hydrodynamics. See Hydraulics.

Hydroelectric power. See Electric power; Water power.

Hydrofluoric acid, *HY droh flu AWR ihk,* is an *extremely* dangerous inorganic chemical. It is produced by dissolving hydrofluoric gas in water. The chemical formula of hydrofluoric acid is HF. Neutralization of the acid forms salts called *fluorides.*

Hydrofluoric acid is used in manufacturing aluminum and certain refrigerants. Industry also uses it to etch glass. In the laboratory, hydrofluoric acid is used in separating uranium isotopes (see **Uranium**).

Hydrofluoric acid is a colorless liquid with an irritating odor. The acid fumes when exposed to air. It is highly corrosive and can cause serious, painful burns to

E. R. Degginger

Commercial hydrofoils typically serve as passenger ferries between islands, along seacoasts, and on rivers. The commercial hydrofoil shown at the left operates on a waterway in Hong Kong.

the skin, eyes, and mucous membranes. Burns from dilute hydrofluoric acid may not be immediately evident, but may appear later as deep ulcerations.

Hydrofluoric acid corrodes glass, ceramic, and many metals. As a result, hydrofluoric acid is usually stored in polyethylene bottles and polyethylene-lined drums.

Carolyn J. Smith

Hydrofoil is a boat whose hull can lift above the surface of the water when traveling at high speeds. The craft has wings that are designed to move underwater. These wings, which are called *foils,* have a curved upper surface and work like airplane wings to lift the hull above the water.

The foils are attached to the hull of the boat by long, thin supports called *struts.* At low speeds, the hydrofoil moves through the water on its hull. When the craft reaches higher speeds, water rushes over the foils at a faster rate. This water action decreases the pressure on the top of the foils and causes them to rise in the water. The hull of the hydrofoil then "flies" above the water on its foils. The lift of the foils supports the hull on its struts.

Hydrofoils use less engine power than other kinds of vessels when traveling at high speeds because their hulls do not have to be pushed through the water. They generally travel at speeds from 30 to 55 knots (nautical miles per hour). Experimental craft have reached speeds of more than 80 knots.

An important feature of hydrofoils is their ability to ride smoothly in rough water at high speeds. The foils act to reduce the effects of waves on the craft, both when it is *foilborne* (traveling on its foils) and when it is *hullborne* (traveling on its hull).

Commercial hydrofoils carry hundreds of thousands of passengers and many tons of supplies and equipment each year. Passenger hydrofoils operate between the islands of Greece, across the English Channel, and in many other parts of the world. Russia operates the largest fleet of commercial hydrofoils.

Military hydrofoils perform such duties as carrying out patrol missions and tracking enemy vessels at high speeds. Some carry guided missiles. Russia has more military hydrofoils than any other country. China, Italy, the United Kingdom, and the United States also operate military hydrofoils.

Kinds of hydrofoils

Hydrofoils range from about 15 to 200 feet (4.5 to 61 meters) in length. Most are powered by gas turbine or diesel engines, or both. Propellers or waterjets propel the craft.

When a hydrofoil is foilborne, its weight is generally distributed between two foils, one at the bow and one

Boeing Marine Systems

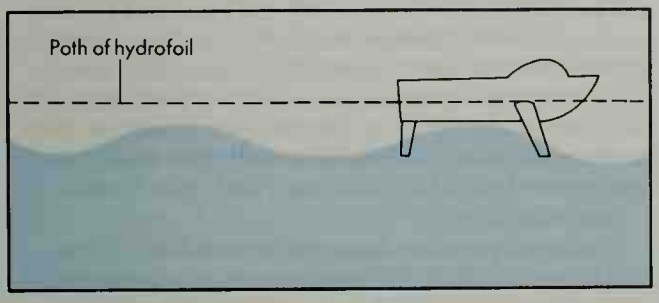
Military hydrofoils, such as the United States Patrol Hydrofoil Missileship (PHM) shown at the left, are used primarily to patrol coastal waters and to track enemy vessels. PHM's carry guided missiles.

at the stern. In the *canard system,* the foil at the stern is larger than the one at the bow. In the *tandem system,* both of the foils are of equal size. The *airplane system* has a larger foil at the bow than it has at the stern.

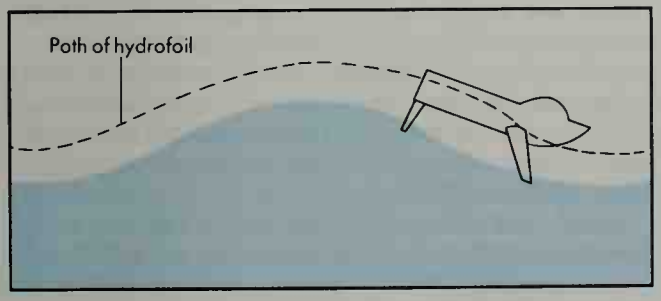
In rough water, hydrofoils change their "flight" path to keep their hulls above the waves. When the waves are small in comparison to the hydrofoil, the craft easily clears the tops of the waves while maintaining a fixed path. This method is called *platforming.* When the waves are large in comparison to the hydrofoil, the craft adjusts its path to follow the shape of the waves. This method is called *contouring. Intermediate response* combines features from both platforming and contouring for traveling over small and large waves. The hydrofoil maintains a fixed path when moving over the small waves, but it follows the shape of the waves when traveling over large ones.

How hydrofoils travel over waves

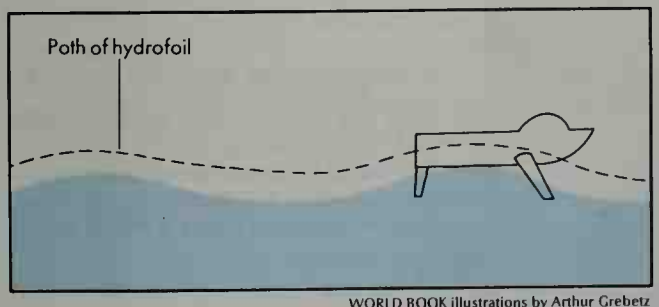
Hydrofoils traveling in rough water keep their hulls above the waves in three basic ways. These methods are (1) platforming, (2) contouring, and (3) intermediate response.



Platforming occurs when the waves a hydrofoil encounters are small in comparison to the size of the craft. The craft maintains a fixed path and the hull easily passes above the water.



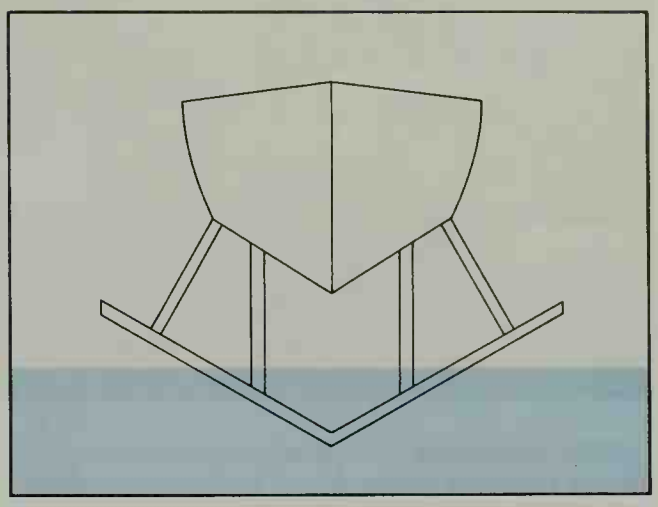
Contouring is used when the waves are large in comparison to the size of the hydrofoil. The craft adjusts its path to match the shape of the waves, and it rides up and down them.



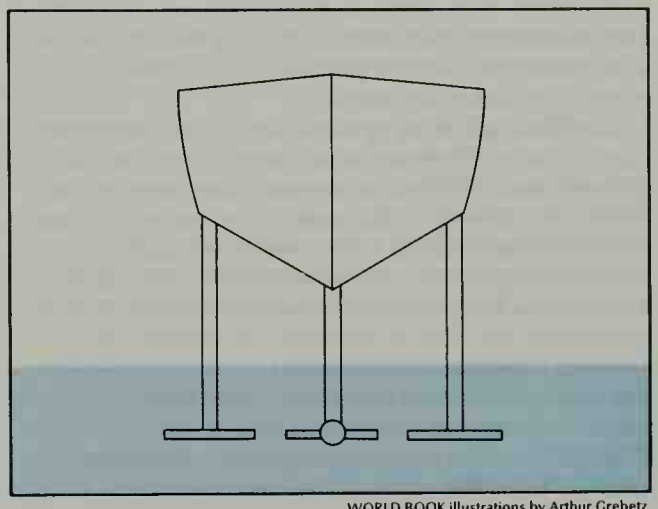
WORLD BOOK illustrations by Arthur Grebetz

Intermediate response combines both platforming and contouring. The craft maintains a fixed path over small waves, but it follows the shape of the waves when passing over large ones.

Two kinds of hydrofoils



Surface-piercing hydrofoils ride on foils that are only partly submerged. The upper part of the foils rides above the surface of the water and helps to stabilize the craft.



WORLD BOOK illustrations by Arthur Grebetz

Fully submerged hydrofoils travel with their foils completely underwater. Fully submerged hydrofoils perform well in rough water but need special stabilizing equipment to ride smoothly.

Hydrofoils are classified according to the way their foil systems operate when they are foilborne. There are two basic types: (1) surface-piercing hydrofoils and (2) fully submerged hydrofoils.

Surface-piercing hydrofoils are most commonly used on rivers, lakes, and other areas where the water is relatively calm. Two popular types of surface-piercing craft are the *V-foil hydrofoil* and the *trapeze-foil hydrofoil.* The V-foil hydrofoil has foils that form a "V" shape. The trapeze-foil hydrofoil has foils that form part of a trapezoid.

Surface-piercing hydrofoils use the surface area of the foils for stability and control. When a surface-piercing hydrofoil is in "flight," the upper parts of the foils stick out of the water. The speed of the craft determines the distance of the hull above the water. As the speed of the craft increases, the foil area required for lift decreases, and the upper part of the foil therefore rises out of the water. When the speed decreases, more area is required to lift the craft, and the foils settle deeper into the water.

Tass from Sovfoto

Shallow draft hydrofoils are a common means of water transportation in Russia. Soviet scientists developed the shallow draft hydrofoil during the 1940's, and such craft began regular commercial service in the Soviet Union in 1957.

Fully submerged hydrofoils are used most often in oceans or other areas where exceptionally rough water might be encountered. The foils of a fully submerged hydrofoil stay completely underwater when the craft is in "flight." The craft is kept stable by changing the angle of the foils, called their *angle of attack,* to keep water flowing over them at an even rate. The angle of attack of fully submerged hydrofoils is changed through the use of automatic stabilizing systems. These systems are either electrical or mechanical.

Electrical stabilizing systems use *sensors* (detecting devices) to pick up changes in the size of the waves. The sensors feed this information into a computer, which sends signals to the craft's stabilizing equipment to adjust the angle of attack. Some craft make such adjustments through the use of movable flaps on the foils. Others have air pumps that create an air cavity around the foils.

Mechanical stabilizing systems use floats attached to the foils by mechanical links to change the angle of attack. The floats ride along the surface of the water. As they travel up and down the waves, they move the mechanical links. The action of the mechanical links then rotates the foils.

Fully submerged hydrofoils called *shallow draft hydrofoils* have the self-stabilizing ability of surface-piercing hydrofoils. The foils of these craft lose lift as they approach the water surface and do not rise higher than one *chord* (the distance from the front edge to the back edge of the foil) from the surface. They maintain this height as long as their speed is kept constant. These craft are used on calm, shallow waterways.

History

Early hydrofoil experiments began in Europe during the late 1800's. In 1906, an Italian engineer named Enrico Forlanini successfully tested the first full-sized, self-propelled hydrofoil. In 1907, the Scottish-born inventor Alexander Graham Bell started work on a series of hydrofoils he called *Hydro-Dromes.* In 1918, one of these craft, the *HD-4,* set a world water speed record of 61.6 knots. This record remained the top speed for a hydrofoil until 1963, when an experimental hydrofoil developed in the United States, the *Fresh I,* set the new record of 84 knots.

Modern hydrofoil development. In 1927, Baron Hanns von Schertel, a German engineer, started work on designing a hydrofoil for commercial use. After nine years of trials, Schertel developed a surface-piercing V-foil that eventually became the first passenger hydrofoil to be put into regular service. During World War II (1939-1945), Schertel and his design team created 15 different types of hydrofoils for the German military.

In 1945, Rostislav Alekseev, a Soviet scientist, began experiments that led to the development of the shallow draft hydrofoil. In 1957, Alekseev's first shallow draft vessel, the *Raketa,* began passenger service on the Volga River in western Russia.

In 1947, the United States Navy began extensive research into hydrofoils and soon became the world's

Photo by Gilbert H. Grosvenor, Courtesy and © National Geographic Society. Courtesy of Bell Family.

An early hydrofoil boat, built by Alexander Graham Bell, had foils arranged like rungs on a ladder. In 1918, Bell's boat set a world water speed record of 61.6 knots. This record remained the top speed for a hydrofoil until 1963, when an experimental hydrofoil reached a speed of 84 knots.

leader in the development of oceangoing hydrofoils. In 1958, it launched *Sea Legs,* the first fully submerged hydrofoil craft to meet with great success. During the 1960's, the U.S. Navy launched a number of fully submerged hydrofoil vessels, including the *Tucumcari* and the *Flagstaff,* both gunboats. During the late 1970's and early 1980's, the Navy commissioned six fully submerged hydrofoils called *Patrol Hydrofoil Missileships* (*PHMs*). They were designed for tracking enemy vessels and launching missiles against them. John D. Bogus

See also Missile boat; Ship (Other passenger vessels).

Hydrogen is a tasteless, odorless, colorless gas and one of the most important chemical elements. The hydrogen atom is the smallest and simplest atom known. This atom consists of one proton, which has a positive charge, and one electron, which has a negative charge. Hydrogen has the chemical symbol H. Its atomic number is 1. Its atomic weight is 1.0079. The term *hydrogen* comes from two Greek words meaning *water-former.* Hydrogen gas and oxygen gas combine to form water.

Occurrence. Hydrogen is the most abundant element in the universe. The sun and many other stars consist mostly of hydrogen. The great number of hydrogen atoms in the earth's crust makes it the third most abundant element on the earth, after oxygen and silicon. However, because of the small size of its atoms, hydrogen accounts for less than 1 per cent of the crust's weight, ranking ninth among the elements. Most of this hydrogen is combined with other chemical elements, as in water. But pockets of pure hydrogen gas can collect in underground mines and cause violent explosions.

Hydrogen occurs in almost all organic compounds. Many of the compounds found in plant and animal tissues are organic. Compounds called *hydrocarbons* contain only hydrogen and carbon. Mixtures of various hydrocarbons make up petroleum and natural gas. Ammonia, most acids, many bases, and most plastics also contain hydrogen.

Properties. Henry Cavendish, an English scientist, discovered the properties of hydrogen and identified it as an element in 1766. Hydrogen may be condensed to a liquid that boils at −257.87 °C and freezes at −259.14 °C. Hydrogen gas has the lowest density of any known substance. At 20 °C, the gas has a density of 0.00008375 gram per cubic centimeter, making it about 14 times lighter than the same volume of air. Hydrogen gas is only slightly soluble in water. It is not poisonous.

Hydrogen, like most other elements, has more than one *isotope.* Isotopes are atoms of the same element that have different numbers of electrically neutral neutrons in the nucleus. Hydrogen has three isotopes. In the most common hydrogen isotope, *protium,* the nucleus consists of only a proton. In 1932, Harold C. Urey, an American chemist, discovered the second isotope, called *deuterium* or *heavy hydrogen.* For this discovery, Urey won the 1934 Nobel Prize in chemistry. The nucleus of a deuterium atom has one proton and one neutron. Deuterium atoms make up about 1 part in 6,700 parts of normal hydrogen. In 1934, scientists discovered the third isotope, *tritium.* Its nucleus has one proton and two neutrons. It is radioactive and has been used in the hydrogen bomb. See Deuterium; Tritium.

Preparation of hydrogen. In the laboratory, hydrogen can be produced by the electrolysis of water (see Electrolysis). In electrolysis, an electric current breaks down the water into its two elements, the gases hydrogen and oxygen. Commercially, large amounts of hydrogen are a by-product of the manufacture of sodium hydroxide by the electrolysis of brine. But most commercial hydrogen is produced either by passing steam over hot coke or iron or by causing steam and natural gas to react in the presence of a catalyst (see Catalysis).

Sodium and many other chemically active metals react directly with water and release hydrogen from the water even at room temperature. Less active metals, such as magnesium, will free hydrogen from steam (see Electromotive series). Zinc and many other metals react better with acids than they react with water. These metals are used to displace hydrogen from solutions of acids in water.

Hydrogen compounds. Hydrogen combines directly with several of the most active elements, but most hydrogen compounds are made by indirect methods. When two hydrogen atoms unite and form a molecule, they give off relatively large amounts of heat. Hydrogen's ability to ignite makes it useful in producing a number of compounds. For example, mixtures of hydrogen and oxygen explode violently when ignited by a spark. In the presence of air or oxygen, hydrogen burns with a hot flame and forms water. Chlorine burns in hydrogen and forms a colorless gas, *hydrogen chloride* (HCl). Solutions of hydrogen chloride in water are known as *hydrochloric acid.* In the Haber process, ammonia (NH_3) is made by combining hydrogen and nitrogen (see Haber process). Other hydrogen compounds prepared indirectly include *hydrogen peroxide* (H_2O_2), *acetic acid* (CH_3COOH), and *ethyl alcohol* (C_2H_5OH).

Under suitable conditions, hydrogen combines directly with a variety of compounds. In the presence of a catalyst at high temperature and pressure, hydrogen combines with carbon monoxide (CO) to form *methanol,* or wood alcohol (CH_3OH). Hydrogen unites with liquid fats to form solid fats. This process, called *hydrogenation,* is used to convert vegetable oils into semisolid shortenings used in cooking (see Hydrogenation).

Uses. Many hydrogen compounds, such as ammonia, ethyl alcohol, and hydrogen peroxide, have extensive industrial uses. Hydrogen is widely used to recover some metals from their compounds because it is a good *reducing agent.* In other words, hydrogen can withdraw oxygen and other nonmetallic elements from metallic compounds, leaving a pure metal. For example, pure metallic tungsten can be formed by passing a stream of hydrogen over heated tungsten trioxide. The hydrogen removes the oxygen and unites with it, forming water. In the same way, free metal and hydrogen chloride result when hydrogen passes over certain hot metallic chlorides. Water and iron result when iron rust, or ferric oxide, is heated with hydrogen.

Hydrogen's ability to produce heat when united with oxygen makes it a good fuel or fuel enhancer. Scientists have developed or are studying ways to use hydrogen as an energy source. Hydrogen fuel powers the main engine of the orbiter in the United States space shuttle system. In New York City, a power plant uses hydrogen fuel to produce electricity. Engineers have built experimental automobiles that run on hydrogen fuel. By chemically adding hydrogen to coal, coal can be converted

into gasoline, fuel oil, or synthetic natural gas (see Coal [The coal industry]). Carolyn J. Smith

Related articles in *World Book* include:

Ammonia	Cavendish, Henry	Hydrogen iodide
Atom (diagrams: How atoms compare in weight and size; The isotopes of hydrogen)	Gas	Hydrogen peroxide
	Heavy water	Nuclear weapon
	Hydrocarbon	
	Hydrochloric acid	

Hydrogen bomb. See Nuclear weapon; Fallout.

Hydrogen chloride. See Hydrochloric acid.

Hydrogen fluoride. See Hydrofluoric acid.

Hydrogen iodide (chemical formula, HI) is a heavy, colorless gas with a strong odor. Chemists prepare it by combining hydrogen and iodine at 200 °C to 300 °C in the presence of a platinum *catalyst* (a substance that increases the speed of a chemical reaction without being consumed by the reaction), or by adding water to a mixture of iodine and red phosphorus.

Hydrogen iodide dissolves readily in water to form hydriodic acid, also called hydroiodic acid, a *strong* (extremely active) acid. Chemists use hydriodic acid in experiments as a powerful *reducing agent.* Such a substance gives some of its electrons to other substances during a chemical reaction. The acid is too costly for large-scale industrial use. Evan H. Appelman

Hydrogen peroxide, is an important industrial chemical that consists of hydrogen and oxygen. Its chemical formula is H_2O_2.

Hydrogen peroxide, also called *hydrogen dioxide,* is a colorless, syrupy liquid that has a sharp odor. Chemists classify any solution of water and hydrogen peroxide that contains more than 8 per cent hydrogen peroxide as corrosive. Such solutions irritate the skin, eyes, and mucous membranes. Concentrations of hydrogen peroxide higher than 50 per cent can cause serious burns.

Pure hydrogen peroxide is stable if handled properly and kept free from contamination. Such factors as light, heat, chemical catalysts, dirt, and rust may cause hydrogen peroxide to decompose into water, oxygen, and heat. Decomposition of a sufficiently concentrated hydrogen peroxide solution yields enough heat for an explosion. Contact with combustible materials may result in fire. However, hydrogen peroxide's instability makes it a good oxidizing agent because the oxygen freed in decomposition readily combines with other substances.

Hydrogen peroxide is widely used in industry. Solutions containing 3 to 6 per cent hydrogen peroxide are used as antiseptics and germicides and as a skin cleanser. Higher concentrations are used in the manufacture of many chemical compounds. They also serve as bleaching agents for textiles and paper pulp, and as rocket propellants. Carolyn J. Smith

See also Antiseptic; Barium; Bleach; Oxidation.

Hydrogen sulfide is a colorless, extremely poisonous gas. Its chemical formula is H_2S. The gas has a sweetish taste and a strong odor of rotten eggs. Chemical compounds containing sulfur produce hydrogen sulfide when they react with certain other chemical compounds. This is why the odor of hydrogen sulfide can be detected around decaying organic matter, such as garbage or sewage; when tarnish is removed from silver; in the exhaust of some buses and cars; and around some hot springs.

Hydrogen sulfide is flammable and burns with a pale blue flame. It dissolves slightly in water, forming a weak acid called *hydrosulfuric acid,* whose formula is also H_2S. Chemists make hydrogen sulfide in the laboratory by combining such strong acids as hydrochloric acid with such metal sulfides as iron sulfide. They use the gas to analyze the composition of mixtures and to produce other compounds. Carolyn J. Smith

Hydrogenation, *HY druh juh NAY shuhn,* is a chemical process that adds hydrogen to a substance. Liquid oils are often hydrogenated to produce solid fats. For example, peanut oil is hydrogenated to change it to a solid and improve its odor and flavor. The hydrogenation process is important in refining gasolines. Hydrogen is added to the smaller molecules of gasoline that result when larger gasoline molecules have been cracked by heat and pressure. Hydrogenation is used in making crude oil from coal. In this process, powdered coal is mixed with a little oil and hydrogenated under heat and pressure.

A substance whose molecules contain some hydrogen atoms, but can accept more, is said to be *unsaturated.* For example, the gas *ethylene* (C_2H_4) is an unsaturated compound. When ethylene is hydrogenated, the double *bond* (chemical connection) that links its two carbon atoms breaks. Two hydrogen atoms are added to the molecule, and a single bond remains. The resulting compound is a gas called *ethane* (C_2H_6). Ethane is called a *saturated* compound because its molecules contain as many hydrogen atoms as they can.

Catalysts (substances that speed up chemical reactions) are needed to make hydrogenation economical. In 1912, French chemist Paul Sabatier received the Nobel Prize in chemistry for discovering that nickel is a good hydrogenation catalyst. Other catalysts for hydrogenation include platinum and *Raney nickel* (an aluminum-nickel alloy treated with caustic soda). Robert J. Ouellette

See also Coal (Coal research).

Hydrography, *hy DRAHG ruh fee,* is the branch of physical geography that deals with the surface waters of the earth, especially with regard to navigation. Hydrographers make surveys of navigable water, including oceans, rivers, and lakes. They publish charts and maps that show water depths and the position of coastlines, channels, reefs, and shoals. Hydrographers also study tides, currents, and winds.

Most countries have developed well-organized hydrographic agencies. Hydrographic work in the United States is carried on by the National Ocean Survey, by the Office of the Oceanographer of the Navy, and by the Corps of Engineers of the Army. Canada maintains a hydrographic service in its Department of Energy, Mines, and Resources. David S. McArthur

See also Geology (picture: Hydrographers).

Hydrology, *hy DRAHL uh jee,* is the study of the movement and distribution of the waters of the earth. People use billions of gallons of fresh water every day. *Hydrologists* (scientists who study water) help provide information needed to find adequate supplies of fresh water. They also study floods and water pollution. In addition, hydrologists study the chemical and physical properties of water.

In nature, water circulates through a system called the *water cycle* or *hydrologic cycle.* This cycle begins

when heat from the sun causes ocean water to evaporate and become water vapor. The atmosphere holds the water vapor while the vapor gradually cools and forms clouds. The water eventually falls as rain or snow. Most rain and snow falls back into the oceans. But some falls on the land and flows back to the seas, completing the cycle. See **Water** (Nature's water cycle).

There are two main sources of fresh water: (1) surface water and (2) ground water. Surface water flows over the land in lakes, rivers, and streams. Ground water seeps through the soil or through tiny cracks in rock. Some ground water flows in underground rivers.

Hydrologists study the water cycle to locate sources of fresh water. They help choose the best sites to drill wells to find ground water in desert areas. Hydrologists also help plan dams and irrigation projects.

Hydrologists try to prevent or reduce water pollution. They study the effects of pollution as it moves through the water cycle.

Hydrology provides information that scientists need to predict and control floods. Architects and civil engineers use this information to help plan towns and roads near waterways where floods often occur.

Douglas S. Cherkauer

Hydrolysis, *hi DRAHL uh sihs,* is a chemical reaction involving water as one of the reacting substances. Its name comes from two Greek words meaning *water* and *loosening.* In industry, hydrolysis is important in making soap, sugar, alcohols, hydroxides, and silicones.

Hydrolysis produces either of two chemical changes: (1) the acidity of the reacting system may change, or (2) molecules of both water and another substance may split and recombine to form new substances.

An example of hydrolysis that increases the acidity of a system is the reaction of antimony chloride ($SbCl_3$) with water. This hydrolysis produces antimony oxychloride (SbOCl) and hydrochloric acid. In the chemical equation, the presence of the acid is indicated by the *hydronium ion* (H_3O^+). This equation is written:

$$SbCl_3 + 3H_20 \rightleftarrows SbOCl + [2H_3O^+ + 2Cl-]$$

An example of hydrolysis that decreases the acidity of a system is the reaction of sodium carbonate (Na_2CO_3) with water. This hydrolysis forms a mixture of sodium ions (Na^+), bicarbonate ions (HCO_3^-), and hydroxide ions (OH^-). The chemical equation is written:

$$Na_2CO_3 + H_20 \rightleftarrows 2Na^+ + HCO_3^- + OH-$$

An example of hydrolysis in which molecules of both water and another substance split and recombine differently is the reaction of sucrose (cane sugar, $C_{12}H_{22}O_{11}$) with water in the presence of acid. This hydrolysis produces two simpler sugars, glucose and fructose. These simpler sugars have the same chemical formula ($C_6H_{12}O_6$), but they differ in molecular structure. The chemical equation for the hydrolysis of sucrose is:

$$C_{12}H_{22}O_{11} + H_2O \xrightarrow{\text{acid}} \underset{\text{glucose}}{C_6H_{12}O_6} + \underset{\text{fructose}}{C_6H_{12}O_6}$$

The hydrolysis of sucrose is an important part of digestion. Sucrose cannot be used by the body, but glucose and fructose can. Robert J. Ouellette

See also **Acid; Base; Neutralization.**

Hydrometer, *hy DRAHM uh tuhr,* is an instrument used to determine the density of liquids. The design is based on Archimedes's principle, which explains buoyancy. The principle states that a body in liquid seems to grow lighter and that the loss of weight is equal to the weight of the displaced liquid.

The hydrometer is usually a glass tube with a weight in the bottom. It is placed in the fluid to be measured and allowed to float. The density of the fluid can be determined by measuring the surface level of the fluid against a scale marked on the side of the tube. When the density of the fluid is divided by the density of water, the result is called the *specific gravity* of the fluid. If the specific gravity of a liquid is less than one, a hydrometer will sink lower in that liquid than it will in water.

One type of hydrometer, called a *lactometer,* is used to test the purity of milk. An *alcoholometer* is used to test alcohol. The strength of brine in the boilers of seagoing ships is tested with a *salinometer.*

One type of hydrometer is made especially to test storage batteries. It is called an *acidimeter,* and is used to determine the amount of acid in the batteries. The concentration of battery acid increases the density of the liquid in the battery. Richard A. Martin

See also **Density.**

Hydrophobia. See **Rabies.**

Hydrophyte. See **Water plant.**

Hydroplane is a high-speed motorboat that skims over the water almost in the way a flat skipping stone does when thrown. The boat's bottom is shaped to lift the hull as it speeds up, until the boat is "planing" over the surface. The shape of the bottom allows the pressure of the water to lift the boat and keep it on the surface as long as it keeps moving quickly. For this reason, the bottom must be flat, or only slightly curved. In some hydroplanes, the bottom is a single surface. Others have two or more separated bottom sections. Many racing hydroplanes are called "three-point" boats. The only parts of the boat that touch the water at high speed are a float, or *sponson,* on each side of the hull, and the propeller. See also **Motorboat racing.** Michele Weston

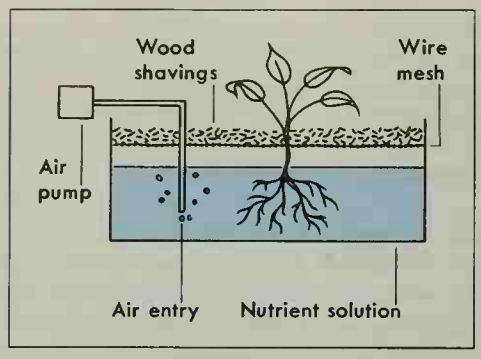
Hydroponics is a term that refers to the science and technology involved in growing plants without soil. It is also known as *soilless agriculture, nutriculture,* or *chemical culture.* The word *hydroponics* comes from two Greek words meaning *water* and *labor.*

All plants require a mix of *nutrients* (nourishing substances) for proper development and growth. Land plants obtain such nutrients as oxygen, nitrogen, phosphorus, and potassium primarily by absorbing them from the soil through the plant root system. Plants in hydroponic systems, however, receive nutrients directly from water. The plants are typically grown in containers that range in size from small pots for individual plants to huge tanks for large-scale growing. Plants growing without soil require the same amount of light and warmth that they would if they were growing in soil. Growers who use hydroponics indoors must provide sources of light and heat.

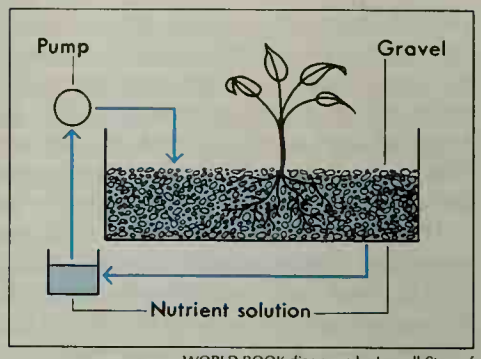
Scientists began understanding the nutritional needs of plants during the 1800's. These discoveries allowed for the development of modern hydroponics. During World War II (1939-1945), members of the U.S. military grew vegetables hydroponically on islands in the Pacific that lacked fertile soil. Today, commercial farmers, researchers, and hobbyists use hydroponics to grow such

Growing plants by hydroponics

Hydroponics involves growing plants without soil by one of two chief methods. The plants may be suspended with their roots in a tank of water, or the roots can be placed in such material as coarse sand or gravel.



Growing plants in water



WORLD BOOK diagrams by Lowell Stumpf

Growing plants in gravel

produce as tomatoes and cucumbers.

Methods of hydroponics. There are two main methods of growing plants without soil. They are *water culture* and *aggregate culture*.

In water culture, plants are suspended with their roots submerged in water that contains plant nutrients. The roots absorb water and nutrients but do not anchor the rest of the plant. Therefore, the plants must be mechanically supported from above. Because the roots also take in oxygen, air must be regularly pumped or mixed into the nutrient solution.

In aggregate culture, the roots not only absorb water and nutrients, but also anchor the plant. Instead of being placed directly in a water and nutrient solution, the roots are placed in a *substrate material,* such as coarse sand, gravel, peat, perlite, or vermiculite. A nutrient solution is either pumped up from below the roots or trickled down from above them.

There are many types of nutrient solutions. A basic solution might consist of potassium nitrate, ammonium sulfate, magnesium sulfate, monocalcium phosphate, and calcium sulfate dissolved in water. Once the solution is in the tank, small amounts of manganous sulfate and a few drops of sulfuric acid would be added once a month and small amounts of ferrous sulfate would be added once a week.

All plant nutrients must be added to the water to allow for proper growth. The nutrients a plant receives in its early growth stages will largely determine how well the plant will grow and its later quality. Only a person skilled at studying a plant's *foliage* (leaves) is likely to recognize signs of poor nutrition at an early stage. By the time poor growth is noticed, it may be too late to correct the deficiency that caused it.

Importance of hydroponics. Scientists have not conclusively proved that hydroponics can produce sturdier plants and better and larger crops than traditional methods. However, growing plants without soil is an effective way to study the needs of plants. By varying the amounts of nutrients, scientists can find the best ratio for successful growth. In addition to being a valuable research tool, hydroponics has the potential to reduce concerns over such issues as groundwater pollution, soil conservation, and pest control. It may also be useful in regions with poor soils or harsh climates.

William H. Carlson

See also Botany (picture: Botanical research).

Hydrosphere. When we think of the earth, we think mostly of areas of land. However, the land actually makes up only a small part of the world. Water, or the *hydrosphere,* makes up most of the earth's surface. The hydrosphere consists of all bodies of water and ice, plus water vapor in the atmosphere. We see the hydrosphere mostly in the basins of lakes and oceans. In some parts of the Pacific Ocean, the hydrosphere is more than 6 miles (9.7 kilometers) deep.

The hydrosphere resembles another part of the earth, the *atmosphere,* because it is fluid and its pressure and temperature change at different depths. Oceanographers find that even in tropical oceans, the temperature at great depths is just a few degrees above freezing.

More than 97 percent of the hydrosphere's volume is salt water contained in the world's seas and oceans. About 2 percent of the hydrosphere's volume consists of ice stored in the polar icecaps. Less than 1 percent is fresh water found in lakes, rivers, and such forms of ground water as that in caves, geysers, springs, and wells. Water vapor in the atmosphere makes up only one-thousandth of 1 percent of the hydrosphere.

The water on the earth's surface contains many dissolved solid materials. These solids come from the rocks and soil with which the water comes into contact. Salt water has a high content of sodium chloride, or ordinary table salt. Fresh water contains dissolved solids in far smaller amounts. Douglas S. Cherkauer

See also Earth (Earth's spheres); Hydrology; Water.

Hydrostatics. See Hydraulics.

Hydrotherapy, *HY droh THEHR uh pee,* is a method of treating muscle, joint, and skin disorders and injuries by using water. The water may be used in any of its forms, from ice to steam. Most modern hospitals and clinics have hydrotherapy facilities in their departments of physical therapy. Physical therapists use hydrotherapy to alter the temperature of layers of skin tissue.

Physical therapists apply ice in cases of acute injury to muscles and joints. The ice causes the small blood vessels near the skin surface to *constrict* (narrow), reducing swelling and pain. The ice affects the central nervous system by stimulating nerve endings in the skin.

Warm water can be used to promote relaxation, to relieve chronic muscle and joint discomfort, and to improve joint flexibility. Warm water causes the small blood vessels near the skin's surface to *dilate* (widen), bringing more blood to the surface tissues to fight disease there. Warm water in a whirlpool bath is excellent for the removal of dressing and for cleaning wounds in the treatment of burn patients. Physical therapists generally use arm or leg whirlpools to treat small body parts,

© L. Perkins

Hydrotherapy is used to treat the burn patient shown above. The hydrotherapy device has a plastic lining. For sanitary reasons, the lining is replaced for each patient.

Michael C. T. Smith, Photo Researchers

The spotted hyena has massive, powerful jaws and strong teeth that can crack even large bones. Spotted hyenas hunt live prey and also feed on the remains of animals that they find dead.

and whirlpool devices to treat the whole body. The buoyant effect of water is important when a patient is trying to regain strength in weak or partly paralyzed muscles. In such cases, the patient may do exercises in a therapeutic pool. Doctors also use warm-water hydrotherapy to wash out the stomach, the bowel, or other body cavities.

Health resorts called *spas* offer medicinal bathing in mineral waters, therapeutic steam baths, and other forms of hydrotherapy. In Europe, famous spas are located in Karlovy Vary, the Czech Republic; Vichy, France; and Baden-Baden, Germany. In the United States, popular spas include those in Hot Springs, Ark., and Saratoga Springs, N.Y. Mary T. Moffroid

See also **Bath; Mineral water.**

Hydroxide, *hy DRAHK syd,* is a chemical *ion.* An ion is one or a group of atoms with an electric charge that act together in chemical reactions. The hydroxide ion has a negative charge and is composed of a hydrogen atom and an oxygen atom. Its chemical formula is OH^-. Many compounds containing the hydroxide ion dissolve in water solutions, producing *ionic solutions.* For example, sodium hydroxide (NaOH) dissolves to form sodium ions (Na^+) and hydroxide ions (OH^-) in water. The hydroxide ion combines with metals and certain nonmetals to form compounds that are basic, acidic, *amphoteric* (basic or acidic), or neutral.

Basic hydroxides are the most familiar hydroxides. A dilute solution of ammonium hydroxide (NH_4OH) is household ammonia. Basic hydroxides in water solutions conduct electricity. They have a bitter taste and feel slimy or soapy. Strong basic solutions burn the skin. When a basic hydroxide combines with an acid, water and a salt are formed. Both the acid and the base are neutralized, thereby increasing the alkalinity of the resulting solution and reducing its acidity. Hydroxides are used to make such products as detergents, medicines, paper, and textiles. Mark S. Wrighton

Hyena, *hy EE nuh,* is a mammal that is famous for its weird howl, which resembles a hysterical human laugh. The hyena hunts animals for its food. It also eats the remains of animals it finds dead. Hyenas have powerful jaws and strong teeth that enable them to crush and eat even large bones.

The most common hyena is the *spotted,* or *laughing, hyena.* Other species include the *striped hyena* and the *brown hyena.* The spotted hyena lives in Africa, south of the Sahara. Its coarse fur is yellowish-gray with black spots. Striped hyenas live in northern Africa and from Turkey to India in Asia. They are smaller than spotted hyenas. Their coats are grayish, with narrow black stripes across the body and legs.

The brown hyena is found in southern Africa, south of the Zambezi River. It has long hair on its back. It has a coarse blackish-gray coat and stripes only on its legs. Farmers who claim that brown hyenas prey on their livestock have poisoned or shot thousands of them. This species is now found in large numbers only in national parks and game reserves, where hunting is prohibited.

Scientific classification. Hyenas belong to the hyena family, Hyaenidae. The scientific name for the spotted hyena is *Crocuta crocuta.* The striped is *Hyaena hyaena.* The brown is *H. brunnea.*

Duane A. Schlitter

See also **Aardwolf.**

Hygiene. See **Health.**

Hygrometer, *hy GRAHM uh tuhr,* is an instrument used to measure the amount of water vapor in the air. Scientists use hygrometers to determine the *relative humidity.* Relative humidity is the amount of water vapor in the air compared with the amount required for saturation of the air at the same temperature. The most common types of hygrometers are the *psychrometer* and the *hair hygrometer.*

The psychrometer consists of two thermometers mounted on the same frame. One type of psychrometer, called the *sling psychrometer* or the *whirled psychrometer,* has a frame that can be whirled in the air by hand. The bulb of one thermometer is covered with a tight-fitting muslin sack and wetted with water. This thermometer is known as the *wet-bulb thermometer.* The other is the *dry-bulb thermometer.* The psychrometer is whirled to provide ventilation for the bulbs. The dry bulb indicates the temperature of the air. The wet bulb helps determine the relative humidity.

When the sling psychrometer whirls through the air,

water from the muslin evaporates. The evaporating water cools the wet bulb. The amount of cooling that occurs depends on the relative humidity. The lower the humidity, the faster the water in the muslin will evaporate, and the more the bulb will cool. High humidity will cause less evaporation, slowing the cooling process.

In air that has less than 100 percent relative humidity, the wet bulb will record a lower temperature than the dry bulb. This difference in temperature is known as *wet-bulb depression.* A special chart is used to convert the wet-bulb depression to relative humidity.

The *Assman psychrometer,* a very accurate type of psychrometer, has a built-in fan. The fan draws the proper amount of air through two stationary metal tubes. These tubes hold wet-bulb and dry-bulb thermometers.

The hair hygrometer uses a bundle of human hairs to detect relative humidity. The length of the hair increases as it absorbs moisture from the air. One end of the bundle of hair is anchored. The other end of the bundle is attached to a lever that moves a pointer on a scale. As the humidity lengthens or shortens the hair, the lever moves the pointer on the scale.

Other hygrometers measure relative humidity by different methods. An *absorption hygrometer* uses a chemical that absorbs water vapor from the air. The chemical gets heavier as it absorbs the moisture, and the change in weight is measured to determine relative humidity. An *electrical hygrometer* uses carbon or some other substance whose electrical resistance responds to changes in humidity. A *dew-point hygrometer* measures *dew point,* the temperature at which the air has 100 percent relative humidity (see **Dew point**). Its polished surface is chilled until dew appears. A device on the surface measures the temperature at which the dew forms.

David D. Houghton

See also **Humidity** (picture: To make a hygrometer).

Hyksos, *HIHK sahs,* were invaders from Palestine and nearby areas who settled in ancient Egypt in the 1700's B.C. They gradually seized control of Egypt from the *pharaohs* (kings). The Hyksos dominated Egypt until 1570 B.C. They introduced the horse, the horse-drawn chariot, new weapons, and perhaps a new type of fortification in Egypt. These changes later helped Egypt to build a vast empire. The Hyksos are sometimes called *shepherd kings.* But the Egyptian word *Hyksos* actually means *chieftains of foreign countries.* See also **Egypt, Ancient** (The Middle Kingdom)

Leonard H. Lesko

Hymenoptera. See **Insect** (table).

Hymn is a song of praise. Most hymns glorify God, but some honor a country or a hero. This article discusses only religious hymns. The ancient Greeks sang hymns to their gods. For nearly 3,000 years, Jews have used the Psalms of the Bible as hymns. Today, both Jews and Christians sing hymns during their religious services. There are hundreds of thousands of hymns. The largest number were originally written in German.

Words and music. Most hymns were originally written as poems and were later set to music. The music of a hymn is called the *hymn tune.* In many cases, a hymn is sung to several tunes, or one tune is used for several hymns. Some hymns have become closely associated with a certain tune, though the words and music may have been written by different people. For example, "O God, Our Help in Ages Past" was written in 1719 by Isaac Watts, an English clergyman. But this hymn is almost always sung to a tune created by William Croft, an English composer. The hymn begins with the verse:

> O God, our Help in ages past,
> Our Hope for years to come,
> Our shelter from the stormy blast,
> And our eternal Home...

Until the 1900's, many hymnals had only the words to songs and were commonly considered books of poetry. In many churches, the people memorized certain hymn tunes, and the minister announced the tune for each hymn. Today, hymnals have both words and music.

Many hymns are set to tunes by great composers. For example, the famous German composer Felix Mendelssohn wrote the music for "Hark, the Herald Angels Sing" in 1840. The words were written in 1753 by English hymnist Charles Wesley. More than 500 of Wesley's hymns are still sung, including "Hark," which begins:

> Hark, the herald angels sing,
> "Glory to the newborn King;
> Peace on earth and mercy mild,
> God and sinners reconciled!"

History. Until the 1500's, most Christians sang hymns in Latin. This practice changed during the Reformation, a religious movement that began in 1517 as an effort to reform the Catholic Church and ended in the establishment of Protestant churches. During the Reformation, many churches in Europe began to conduct religious services in their national language. Martin Luther, a German leader of the Reformation, wrote numerous hymns in German and translated a number of Latin hymns. Luther wrote one of the most popular Protestant hymns, "A Mighty Fortress Is Our God," in 1529. One translation of the hymn begins:

> A mighty fortress is our God,
> A sword and shield victorious;
> He breaks the cruel oppressor's rod
> And wins salvation glorious.

Another Reformation leader, John Calvin of France, strongly supported the Bible as the basis of all religious teachings. In England, Switzerland, and other countries where many churches followed Calvin's teachings, most Christians sang only Biblical Psalms during religious services. As a result, verse translations of the Psalms became the chief hymns in those countries.

During the 1700's, Isaac Watts broke the tradition of basing hymns on the Psalms and wrote many original hymns. Watts became known as the father of English *hymnody*—that is, the composition of hymns.

In the 1800's, Fanny Crosby, an American hymnist, wrote more than 8,000 hymns. During the late 1800's, Dwight Lyman Moody, an American evangelist, and Ira D. Sankey, an American gospel singer, used many of Crosby's hymns in revival meetings throughout the United States. The tunes they sang became popular and are used in many churches today.

Leonard W. Van Camp

Related articles in *World Book* include:

Bay Psalm Book
Cowper, William
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National anthem
Newman, John Henry
Watts, Isaac
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Hypatia, *hy PAY shee uh* (A.D. 370?-415), an Egyptian mathematician and philosopher, was the first noted wo-

man in mathematics. She was also a leader of the philosophical movement called Neoplatonism, which developed from the ideas of the ancient Greek philosopher Plato.

Hypatia was born in Alexandria, Egypt, then a great center of learning. She and her father, Theon, a mathematician and astronomer, coauthored commentaries on the works of Ptolemy, a Greek astronomer who lived in Alexandria. Historians also credit Hypatia with analyses of the works of other mathematicians, including Diophantus, called the father of algebra, who was probably Greek.

Hypatia lectured on philosophy, astronomy, mathematics, and religious literature in her home and at lecture halls in Alexandria. People apparently consulted her on governmental matters. Letters written by Synesius of Cyrene, one of her students, provide the most important information on her life and teaching.

Hypatia was murdered by followers of Saint Cyril of Alexandria, a Christian bishop, because she supported Cyril's political enemy Orestes, the chief Roman officer of the city. Charles Kingsley's novel *Hypatia* (1853) is based on the events surrounding her death.

Ronald S. Calinger

Hyperactivity. See Attention deficit disorder.

Hyperbaric oxygen therapy is a medical treatment in which a patient breathes 100 percent oxygen at pressures greater than atmospheric pressure. Under this high pressure, more oxygen is dissolved into the blood and carried to the tissues and organs. The treatment is performed in an airtight compartment called a *hyperbaric chamber.*

Hyperbaric oxygen therapy is used in treating decompression sickness. This disorder, commonly called *bends,* occurs when underwater divers ascend too quickly to the surface. The sudden decrease in pressure causes nitrogen to leave tissue and form bubbles. These bubbles can deform tissue and block blood vessels. Hyperbaric oxygen therapy reduces the size of the nitrogen bubbles and increases the amount of oxygen in tissues. See Bends.

Hyperbaric oxygen therapy is sometimes used to treat carbon monoxide poisoning. This condition results from inhaling carbon monoxide, a gas released by burning gasoline, natural gas, oil, or other fuels. Carbon monoxide combines with *hemoglobin,* the substance in the blood that carries oxygen to tissues. In doing so, it prevents hemoglobin from transporting oxygen. Hyperbaric oxygen therapy displaces the carbon monoxide and enables hemoglobin to carry normal amounts of oxygen.

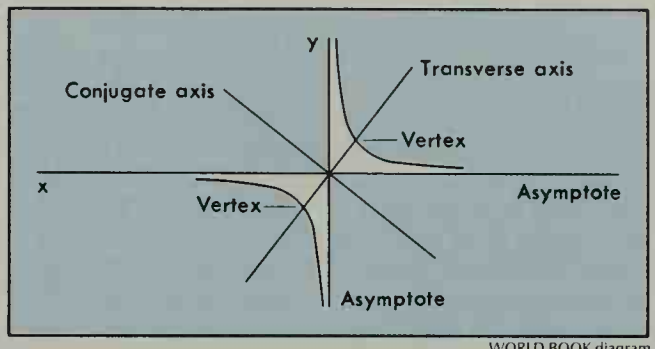
Hyperbaric oxygen therapy is also used to treat *gas gangrene,* a disease that kills tissue. The bacteria that cause the disorder cannot reproduce if oxygen is present. See Gangrene.

Pamela Grim

Barry Adams, Custom Medical

A hyperbaric chamber provides oxygen at pressures greater than atmospheric pressure. A technician controls the flow, pressure, and temperature of the oxygen from outside the chamber.

Hyperbola, *hy PUR buh luh,* is a curve with two branches formed by a plane that cuts through two right circular cones that are joined at their tips. Circles, ellipses, hyperbolas, and parabolas all lie on a cone-shaped surface and so are called *conic sections.*



WORLD BOOK diagram

A hyperbola can be produced by graphing the mathematical equation $y = \frac{1}{x}$, as shown in the diagram above.

The equation $y = \frac{1}{x}$, when graphed, shows a hyperbola. As x increases, the curve flattens out and approaches a straight line called an *asymptote.* The two points at which the axis of a hyperbola's plane intersects the two branches are called the *vertices.* The *transverse axis* connects the vertices. The *conjugate axis* bisects the transverse axis and is perpendicular to it.

Philip S. Marcus

Hypericum. See Saint-John's-wort.

Hyperopia. See Farsightedness.

Hypertension is the medical term for the disease commonly called *high blood pressure.* A blood-pressure measurement includes two numbers that are usually written as a fraction. The normal blood pressure for a young adult is 120/80. Hypertension is diagnosed when one or both numbers are elevated on several separate occasions. In a young adult, a reading is considered abnormal if the first number is higher than 140 or the second number is higher than 90. For information about these numbers, see Blood pressure.

There are many varieties of hypertension. They range from mild forms to an extremely severe—and often rapidly fatal—type called *malignant hypertension.* High blood pressure is not only a serious condition by itself, but it is also the leading cause of heart attacks, strokes, and kidney failure.

Many people of all ages suffer from hypertension. About 20 percent of the people of the United States have the disease. The percentage of black Americans who suffer from hypertension is about twice as large as the percentage of white Americans who have it.

Causes. Some cases of hypertension result from other illnesses, such as kidney disease or overactive adrenal glands. However, in the vast majority of cases, physi-

cians cannot determine the cause of a patient's high blood pressure. Physicians call such cases *essential hypertension.* People whose parents have hypertension are much more likely to develop the ailment than those whose parents have normal blood pressure. *Obesity* (fatness), stress, smoking, or eating too much salt may trigger hypertension in people who have inherited such a tendency. These conditions and habits may also make the disease worse in people who already have it.

Physicians know that an enzyme called *renin* plays an important role in regulating blood pressure. Renin is secreted by the kidneys under certain circumstances, such as a drop in the pressure of the blood flowing through the kidneys. Renin causes the formation of a chemical substance called *angiotensin,* which raises the blood pressure by causing the blood vessels to *constrict* (become narrower). Angiotensin also stimulates the adrenal glands to secrete the hormone *aldosterone.* Aldosterone causes the body to retain sodium, which, in turn, then causes the body to retain fluids. The extra fluid increases the volume of the blood, thereby further raising the blood pressure. After the blood pressure has risen to a certain level, the kidneys normally stop secreting renin. But in many people with essential hypertension, something interferes with this controlling system. In such cases, the blood pressure remains elevated. When the pressure is high inside the heart, the heart releases a hormone called *atrial natriuretic factor.* This hormone helps lower the blood pressure by inhibiting the secretion of renin and aldosterone.

Effects. In most cases, hypertension produces no symptoms until dangerous complications occur. For example, it can cause an artery in the brain to burst, producing a stroke. High blood pressure also forces the heart to work harder, and so it may cause a heart attack. The disease can cause kidney failure by reducing the flow of blood to the kidneys. In addition, high blood pressure is a major cause of *arteriosclerosis* (hardening of the arteries).

Treatment. People of all ages should have their blood pressure checked frequently. Many cases of mild hypertension can be controlled by weight reduction, avoidance of salty foods, and increased exercise. Physicians can control almost all other cases with drugs, including some medications that reduce the secretion of renin and aldosterone. The more serious consequences of hypertension, such as heart attacks and strokes, can be prevented by treating high blood pressure before it reaches dangerous levels. James N. Davis

See also Arteriosclerosis; Heart (Risk factors); Stroke.

Additional resources

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Pickering, Thomas G. *Good News About High Blood Pressure.* Simon & Schuster, 1996.

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Hyperthermia, *HY puhr THUR mee uh,* is a condition that occurs when the body becomes overheated. Normally, when the temperature of the body increases, excess heat is released through the skin. Blood vessels near the skin *dilate* (widen) to bring warm blood to the surface. Heat then escapes and the body cools. The body is also cooled by the evaporation of sweat. When the body is unable to release heat in these ways, illness occurs. Hyperthermia differs from *hypothermia,* a condition in which body temperature is below normal (see Hypothermia).

People usually seek relief from extreme heat before they feel ill. At times, however, athletes and people who work outdoors may ignore the first signs of illness. Others commonly affected by hyperthermia include elderly people, children, and people with heart disease or other conditions that cause poor circulation.

Forms of hyperthermia. The most common form of hyperthermia is *heat exhaustion.* It is caused by the loss of a large amount of fluid in the body as a result of excessive sweating. It typically strikes people who work for long periods in heat and humidity while wearing heavy clothing. Symptoms of heat exhaustion include headache, nausea, dizziness, and cool, moist, pale, or red skin. The condition is sometimes preceded by painful muscle spasms called *heat cramps.* Heat exhaustion can usually be relieved by immediate first-aid care. But if symptoms are ignored or no care is given, the condition may quickly worsen to a more serious form of hyperthermia called *heatstroke.*

Heatstroke is characterized by vomiting; red, hot, dry skin; rapid pulse; rapid, shallow breathing; and a progressive loss of consciousness. It develops when the body's heat-regulating mechanism is disturbed and sweating stops. The body then cannot cool itself effectively and its temperature rises to a level at which the brain and other vital organs begin to fail. Convulsions, coma, and death may result if the body is not cooled. Heatstroke caused by the sun is commonly called *sunstroke.*

Treatment of hyperthermia involves immediately cooling the body and replacing fluids. Move the victim to a cool environment and provide cool water to drink. Loosen tight clothing and remove perspiration-soaked clothing. Apply cool, wet cloths to the skin and fan the victim.

If the victim refuses water, vomits, or begins to lose consciousness, call for medical help immediately. Cool the victim by applying ice packs or cold compresses to the head, neck, and places where large blood vessels are near the skin. A person suffering heatstroke may experience a heart attack or breathing failure, requiring artificial respiration or *cardiopulmonary resuscitation (CPR)* to be given (see Cardiopulmonary resuscitation).

Critically reviewed by the American Red Cross

Hyperventilation is abnormally rapid, deep breathing. It occurs most frequently if anxiety or emotional stress stimulates the part of the brain that regulates breathing. Certain illnesses, such as kidney failure and diabetes, may also trigger hyperventilation. However, the condition is rarely a serious medical problem.

During hyperventilation, a person exhales too much carbon dioxide. As the level of carbon dioxide in the blood drops, the blood vessels narrow, allowing less blood to circulate. If too little blood reaches the brain, the person feels dizzy and may faint. The calcium in the blood also decreases, causing some muscles and nerves to twitch. The twitching may result in a tingling or stabbing sensation near the mouth or in the chest.

Some symptoms of hyperventilation resemble those of certain heart or lung ailments. These symptoms in-

clude a tight feeling in the chest, as though the lungs cannot receive enough air. This sensation leads to faster and deeper breathing. The heart may begin to pound, and the pulse rate may rise. Such symptoms increase a person's anxiety, which can make the condition worse.

An attack of hyperventilation may last 30 minutes or longer. People who hyperventilate can help control attacks by trying to slow their breathing rate when symptoms of the condition appear. They also can exhale into a paper bag and rebreathe the exhaled air to restore lost carbon dioxide to the body. Brian J. Sproule

Hyphen. See Punctuation.

Hypnos was the god of sleep in Greek mythology. The Romans called him Somnus. Hypnos was a kind and gentle youth, but he had the power to lull to sleep even the mightiest gods. His mother was Nyx, the goddess of night, but he had no father. Thanatos (Death) was his brother. Hypnos had hundreds of sons, called the Dreams. The most famous was Morpheus (see Morpheus). Hypnos lived in a large cave where he slept on a soft, dark bed. Everything in the cave helped bring about sleep. Lethe, the river of forgetfulness, flowed through the cave. Justin M. Glenn

Hypnotic. See Sedative.

Hypnotism, *HIHP nuh tihz uhm,* is the scientific and clinical use of *hypnosis.* Hypnosis, or a *hypnotic state,* is a temporary condition of altered attention in an individual. A hypnotist is a person who uses hypnotism. Scientific evidence suggests that hypnotism is useful when it is practiced by qualified professionals. For example, some professionals use hypnotism to treat patients who have certain medical or psychological problems.

People have used hypnotic techniques since ancient times. But the practice of hypnotism has been condemned at times because of its misuse or because of ignorance, mistaken beliefs, and overstated claims. Today, professional organizations accept hypnotism when it is used for valid medical or scientific purposes.

What hypnotism is

Scientists have shown that hypnosis is a natural part of human behavior that affects psychological, social, and physical experience. There is no magic connected with hypnotism, and the hypnotist has no special power. The effects of hypnotism depend on the ability, willingness, and motivation of the person being hypnotized. In hypnosis, a change in the quality and focus of a person's attention alters his or her internal and external experience.

Hypnosis has been compared to dreaming and sleepwalking. The term *hypnosis* comes from the Greek word *hypnos,* which means *sleep.* However, hypnosis is not actually related to sleep. It involves a more active and intense mental concentration. Hypnotized people can talk, write, and walk about. They are usually fully aware of what is said and done.

A hypnotist uses certain methods to *induce* (guide) hypnosis in another person. As the person responds to the methods, the person's state of attention changes. This altered state often leads to various other changes or phenomena. For example, the person may experience different levels of awareness, consciousness, imagination, memory, and reasoning or become more responsive to suggestions. Additional phenomena may be produced or eliminated. Such phenomena may include sensations, blushing, blood flow, sweating, paralysis, tensing of muscles, and *anesthesia* (loss of pain sensation). Scientists have shown that changes in almost every body function and system may occur with hypnosis.

None of the experiences of hypnosis are unique. Some or all of the phenomena can occur without the use of hypnotic techniques. For example, people who are very responsive to hypnosis show an increased responsiveness to suggestions before they are hypnotized. This responsiveness increases during hypnotism.

People once believed that hypnotists could force their subjects to perform criminal acts or other actions against the subjects' will. There is no clear evidence to support this belief. Hypnotized people can and do resist suggestions. They do not lose control of their actions and can distinguish between right and wrong.

Public performances of hypnotism are responsible for many popular misconceptions about hypnosis. Many people are first exposed to hypnotism through a magic show or a motion picture. Such presentations often make hypnotism appear simple. They may tempt untrained people to try to perform hypnotism on themselves or on other people. Because of these possible dangers, many governments have outlawed public performances of hypnotism.

The hypnotic experience

Some people can go into hypnosis within a few seconds or minutes. Others cannot be hypnotized easily. There are various levels of hypnosis. For example, with light hypnosis, the person becomes rested and follows simple directions easily. In deep hypnosis, complete anesthesia may be experienced. The level of hypnosis is not usually related to the effectiveness of treatment.

Inducing hypnosis in another person can be achieved through several techniques. Perhaps the best-known techniques use direct commands. These commands consist of simple suggestions repeated continuously in much the same tone of voice. The hypnotist instructs the subject to focus his or her attention on an object or fixed point, such as a spot on the ceiling. Then the hypnotist tells the subject to relax, breathe deeply, and allow the eyelids to grow heavy and to close.

Many professionals use verbal and nonverbal techniques known as *indirect inductions.* Such procedures usually omit the use of a focal object. The subject responds to a story or a mental puzzle presented by the hypnotist. The hypnotist does not tell the patient to relax or to close the eyes. Instead, the hypnotist suggests these actions indirectly through the story or puzzle. The hypnosis treatment remains much the same.

Some hypnotists give their subjects a challenge suggestion to test for hypnosis. For example, the hypnotist may say, "You will have difficulty moving your right hand." The person may then find the movement difficult or impossible to perform. Such tests do not necessarily indicate a hypnotic state. They may merely demonstrate a person's response to suggestion.

Historically, various drugs occasionally have been used to help induce hypnosis. These drugs include thiopental ("truth serum"), alcohol, and other drugs. However, drugs and special tools or other gimmicks are rarely necessary for inducing hypnosis. Most professionals do not make use of them.

Hypnotic phenomena. Hypnosis brings about many different kinds of experiences. A hypnotized person may experience changes in awareness, creative imagination, reasoning, and wakefulness. Physical changes within the body also may be produced by suggestion. These phenomena include changes in blood flow, blood pressure, heart rate, and sensations of cold and heat.

Professionals sometimes focus on a certain phenomenon of hypnosis to help treat their patients. One useful phenomenon is the ability of some hypnotized people to remember forgotten experiences. After people have a shocking or painful experience, they often *repress* (block) memories of it from their conscious thoughts. Sometimes, the repressed memories influence the person's normal behavior and result in certain forms of mental illness. For example, during World War II (1939-1945), soldiers occasionally developed *amnesia* (loss of memory) as a result of some of their experiences. Through hypnosis, doctors helped the patients remember their experiences and relieve the emotional tensions that had built up. This treatment helped the patients regain their health.

Another hypnotic phenomenon is called *age regression.* The doctor suggests that the hypnotized patient is a certain age. The patient may then recall or "relive" incidents in his or her life. If the doctor suggests that the patient is 7 years old, for example, the patient may appear to talk, act, and even think much as a 7-year-old. In this way, patients may remember events and feelings that may have had some bearing on their present illness. The patient can then reinterpret the situation with additional information and increased coping skills.

Sometimes, on the hypnotist's command, subjects may believe they are living in some past or future time. They may feel that they have traveled back to the Middle Ages or on to the next century. Untrained hypnotists may look upon such changes as proof that the individual was or will be reincarnated. Professionals consider these fantasies to be much the same as dreams.

Ending the hypnosis session is generally not difficult. A person usually remains in hypnosis until given a signal by the hypnotist. The hypnotist may count to five, make an indirect suggestion, or produce some type of sound. Sometimes the subject ends the experience even when no signal is given. Occasionally a hypnotist may have difficulty ending the hypnosis. This problem is one of the reasons why only trained professionals should practice hypnotism.

Uses of hypnotism

Modern methods of hypnotism have helped scientists increase their understanding of the human mind and body, and normal and abnormal behavior. Hypnotism is used in research; in medicine, particularly surgery and dentistry; and in psychotherapy (see **Psychotherapy**). Hypnosis has occasionally been used in legal cases.

Hypnotism has been the subject and a tool in many studies. Tests have been developed to measure a person's hypnosis experience. Research has shown that children can usually be hypnotized more easily than adults and that males and females can be hypnotized.

Some physicians use hypnosis as a sedative to soothe patients who are nervous or in pain. Some patients become less aware of pain with hypnosis, while others report no pain at all. Physicians may use deep hypnosis as a form of anesthesia, so that patients will feel no pain while undergoing surgery or childbirth. Hypnotism has also been used to lessen the discomfort of patients recovering from surgery or other medical procedures.

Physicians also have made use of the ability of a hypnotized person to remain in a given position for long periods of time. In one case, doctors had to graft skin onto a patient's badly damaged foot. First, skin from the person's abdomen was grafted onto his arm. Then the graft was transferred to his foot. With hypnosis, the patient held his arm tightly in position over his abdomen for three weeks, then over his foot for four weeks. Even though these positions were unusual, the patient at no time felt uncomfortable.

Some dentists may use hypnotism as an anesthetic. After the patient has been hypnotized, the dentist drills the tooth and fills the cavity. The patient remains relaxed and feels comfortable throughout the procedure.

Mental health professionals who may use hypnotism include psychiatrists, psychologists, and clinical social workers. Therapists may use hypnosis as the main focus or as a part of the treatment. Hypnotism may be used to calm disturbed patients. This treatment may help the patients to become more aware of their feelings, modify their behavior, and learn new ways of thinking and solving problems. Psychological conditions that have been treated through hypnosis include anxiety, depression, phobias, stress, and problem solving.

Hypnosis helps some people control or stop such problem habits as eating disorders and smoking. Hypnotism has been used to improve learning, reading, sleep, speech problems, sports performance, and behavioral problems.

Hypnotism can also be effective in controlling certain physical problems that are linked to psychological factors. These so-called *psychophysiological* problems include certain conditions in the nervous system, as well as some ailments of the heart, stomach, and lungs. Hypnotism occasionally has aided in the treatment of patients with chronic illnesses like arthritis, cancer, multiple sclerosis, pain, and stroke.

Hypnosis occasionally has been used with witnesses and victims of crime. In hypnosis, people may remember important clues, such as a criminal's physical appearance or another significant detail that might help in solving the crime. Care must be taken to also obtain independent information as people can lie and make mistakes while hypnotized. Hypnosis cannot make a person give away a secret.

Dangers of hypnotism

Hypnotism can only be dangerous if it is abused. Only a qualified professional should practice hypnotism. Although many people can learn to hypnotize, the skill is not a substitute for training in medicine and psychology. People who practice hypnotism need sufficient education and experience to be able to analyze a condition, determine that hypnosis is an appropriate treatment, and evaluate the results.

An untrained person cannot deal with the difficulties that might occur as the result of inappropriately hypnotizing an individual. For example, an unqualified hypnotist may give treatment for the wrong condition or may

Under hypnosis, people can sometimes be made to believe they are living in an earlier period of their lives. The woman in the photograph has been told under hypnosis that she is 7 years old. The top of the illustration at the left shows how she wrote her name and the date before hypnosis. The bottom portion shows these items as she wrote them while hypnotized.

© Peter Gonzalez

overlook significant details. An inappropriate suggestion may mask or cover an illness or symptom. If the hypnotist uses an incorrect method or approach, a symptom may be interpreted as a completely different problem. The symptom may remain undetected, and the subject may not learn the proper skills for solving the real problem. In addition, appropriate nonhypnosis treatment techniques may be ignored or may not be used effectively.

The American Medical Association (AMA) requires all physicians who use hypnosis to do so only for purposes related to their special practice. Similar standards have been set for clinical psychologists and dentists. Ethical codes usually stop professionals from advertising themselves as hypnotists and from listing the problems they treat. Some physicians, dentists, and psychologists take specialty board examinations that certify that they have met advanced qualifications in the use of hypnotism.

Many scientists believe that the use of hypnotism in legal situations can cause serious problems. In 1985, the Council on Scientific Affairs of the AMA reported that memories refreshed through hypnosis may include inaccurate information, false memories, and *confabulation* (fact and fantasy combined). The report recommended guidelines for the legal use of hypnosis. In 1987, the U.S. Supreme Court ruled that in some instances recollections obtained through hypnosis could be used by defendants as testimony in criminal cases.

Some people learn self-hypnosis, also called *autohypnosis.* Self-hypnosis should be used only after an expert has determined that it is the appropriate treatment for the particular problem. A person learning self-hypnosis should have professional instruction. Complications may arise if self-hypnosis is practiced incorrectly.

History

Throughout history, various cultures and groups have used rituals and techniques that can best be described as hypnotism. Hypnotic experiences have been described by the ancient Egyptians and Greeks and by tribal cultures. References to deep sleep and anesthesia have been found in the Old Testament and in the Talmud, a collection of sacred writings of Judaism.

Mesmerism. The scientific development of hypnotism can be traced to the efforts of Franz Anton Mesmer, an Austrian physician who became prominent during the 1770's. Mesmer called his work *animal magnetism.*

Some people believed that disease developed when invisible magnetic fluids were cut off or improperly distributed. Mesmer used water tubs and magnetic wands to direct the supposed fluids to his patients. Many patients claimed that this treatment cured them.

In 1784, a French commission was formed to study the claims of Mesmer and his followers. It reported that the magnetic fluids did not exist. It explained the cures as a product of the patients' imagination.

Many of Mesmer's patients and students helped spread the belief in animal magnetism, which became known as *mesmerism.* Students of mesmerism continued to experiment with some of his methods. Some soon found that magnets or fluids were unnecessary.

Scientific studies. The term *hypnotism* was used by James Braid, a British physician who studied suggestion and hypnosis in the mid-1800's. Braid pointed out that hypnosis differed from sleep and that hypnotism was a physiological response in the subject, not the result of secret powers. Perhaps Braid's most valuable contribution was his attempt to define hypnotism as a phenomenon that could be scientifically studied. During this same period, James Esdaile, a Scottish doctor working in India, began to use hypnotism as an anesthetic in major surgery, including leg amputations. He performed about 200 operations with the aid of hypnosis.

During the late 1800's, the French neurologist Jean Martin Charcot performed landmark experiments involving hypnosis. He found that hypnosis relieved many nervous conditions. His clinic for nervous disorders achieved a widespread reputation among scientists of the time, including the French psychologist Alfred Binet and the Austrian physician Sigmund Freud. Also in the late 1800's, the French physicians Hippolyte Bernheim and Ambroise Auguste Liébeault explored the role of suggestibility in hypnosis. These two scientists used hypnosis to treat more than 12,000 patients.

Freud was especially interested in the work of Charcot and Bernheim. He used hypnotized people in his early studies of the unconscious state. For various reasons, Freud abandoned the use of hypnosis in his clinical practice. However, he continued to view hypnosis as an important research phenomenon. Late in his life, Freud modified his once negative views on hypnotism.

During the early 1900's, the Russian physiologist and psychologist Ivan Pavlov sought to discover a physiological basis of hypnosis. Pavlov maintained that hypnosis is based on *inhibition* (blockage) of certain nerve impulses in the brain.

Hypnotism became widely used by physicians and psychologists during World War I (1914-1918) and World War II (1939-1945). Hypnosis was used to treat battle fatigue and mental disorders resulting from war. After the wars, scientists found additional uses of hypnotism in clinical treatment.

Various American scientists advanced the study of hypnotism during the 1900's. Morton Prince showed that hypnotized people can maintain several mental activities at the same time. Clark L. Hull demonstrated that hypnosis is a form of heightened suggestibility. Milton H. Erickson developed new strategies of hypnotism by combining clinical and research techniques. Harold Crasilneck showed that hypnotic strategies can be effective with stroke patients. Herbert Spiegel described the natural hypnotic talents of patients. The studies of Ernest and Josephine Hilgard helped increase understanding of pain mechanisms in the body. Research by Martin and Emily Orne showed the importance of social and psychological factors in hypnosis. Ray William London

Related articles in *World Book* include:

Freud, Sigmund	Psychiatry	Psychotherapy
Mental illness	Psychoanalysis	Suggestion
Mesmer, Franz A.	Psychology	Trance

Additional resources

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Hypochlorous acid, *hy puh KLAWR uhs,* is a weak, inorganic acid that forms when chlorine is added to water. It is unstable and decomposes rapidly when exposed to heat or light. Hypochlorous acid is used as a household bleach and disinfectant. Chemists believe that when chlorine is added to swimming pools and city water supplies, it is the hypochlorous acid that forms which kills the bacteria. Neutralizing hypochlorous acid produces salts called *hypochlorites.* Both the acid and its salts are powerful oxidizing agents.

Hypochlorous acid is the weakest chlorine acid. Its chemical formula is HOCl, but it is sometimes written HClO. Hypochlorous acid is relatively unstable and has never been isolated in pure form. It usually occurs as a dilute solution of HOCl in water. Carolyn J. Smith

Hypochondria, *HY puh KAHN dree uh,* is a state of mind in which people persistently and morbidly worry about their health, even though they have no disease. Such people, convinced that they are ill, complain of puzzling symptoms. They seek, and may receive, various medical treatments. But at best, they get only temporary relief. Vague symptoms of this kind are frequently seen in people with various types of mental illness, such as hysteria. In popular usage, any person complaining of vague or persistent symptoms may be called a *hypochondriac.* See also **Mental illness.** Nancy C. Andreasen

Hypodermic injection is a method for administering drugs under the skin. Equipment for the injection includes a *syringe* (tube with a plunger attached) and a hollow needle. The needle has a sharp point that permits it to easily go into the skin. The doctor attaches the needle to the syringe barrel, puts the liquid medicine in the syringe, and inserts the needle into the patient's skin. Then, the doctor presses on the plunger to force the medicine through the needle. The hollow needle was invented in 1844 by Francis Rynd, an Irish physician. Charles Pravaz, a French physician, invented the first practical metal syringe in 1853. See **Syringe.**

Hypodermic injections are named for the tissue into which the injection is made. *Intradermal injections* are made between the layers of skin. For these, the doctor inserts a needle just under the top layer of skin. Injections made beneath the outer layers of skin are called *subcutaneous injections. Intramuscular injections* are given into deep muscle tissue. A hypodermic needle can be inserted into a vein to give medicine *intravenously* (see **Intravenous injection**). Edwin S. Munson

© Aaron Haupt, Photo Researchers

A typical hypodermic injection uses a *syringe,* a tube with a plunger, to inject drugs through a hollow needle. The young girl shown in this photo is receiving a vaccination.

© Damien Lovegrove/SPL from Photo Researchers

A jet injector sprays vaccine and other drugs through the skin at high pressure and requires no needle.

Hypoglycemia, *HY poh glih SEE mee uh,* is a condition that occurs when the blood does not contain enough *glucose* (sugar). Glucose provides energy for

the body's cells. Some cells require a continuous supply of glucose. The nerve cells, especially those of the brain, are most seriously affected by too little glucose.

The symptoms of hypoglycemia may include hunger, headache, nervousness, rapidly pounding heartbeat, and sweating. People suffering from more severe hypoglycemia may show confusion, amnesia, poor coordination, and slurred speech. In advanced cases, the patient may lose consciousness and have convulsions. In rare cases, brain damage or death occurs.

Most cases of hypoglycemia occur among people who are taking medicine for diabetes. These people have too little *insulin,* a hormone that regulates the body's sugar. Their blood contains too much sugar, and so they take insulin or a hypoglycemic drug to lower the blood sugar. Hypoglycemia may occur if the dosage is too large or has a stronger effect than intended.

Physicians traditionally classify other cases of hypoglycemia into two groups—*organic* and *functional.* Organic hypoglycemia, which is much more severe than the functional condition, results from a physical abnormality. Various diseases of the liver may lead to organic hypoglycemia. The liver normally stores sugar as *glycogen* (animal starch). The liver reconverts glycogen to glucose and releases it into the blood as the cells need it. A diseased liver may fail to release the proper amounts of glucose. Disorders of the *endocrine* (hormone-producing) glands may also result in organic hypoglycemia. For example, some tumors of the pancreas, the organ that produces insulin, can release too much insulin. The treatment typically involves surgery to remove the tumor and thus correct the abnormality.

The major form of functional hypoglycemia is *reactive hypoglycemia,* which is simply an exaggeration of the body's normal reaction to eating. Normally, the amount of sugar in the blood increases for a few hours after a meal, especially one that includes many *carbohydrates* (starches and sugars). In many healthy people, the glucose level often may drop to a point clearly lower than that before the meal, and then rise back to the starting level. In most people, this drop in blood sugar is not noticed. In a person who has reactive hypoglycemia, the drop in blood sugar to below normal triggers symptoms of hypoglycemia. In most cases, without treatment, the symptoms disappear in a few minutes—or even sooner if the person eats something that contains sugar.

Functional hypoglycemia occurs far more frequently than organic hypoglycemia, but it is not a common condition. Some physicians once did not realize that a temporary fall in blood sugar often occurs normally in response to eating. This lack of knowledge resulted in widespread wrong diagnosis of functional hypoglycemia. Many common problems, such as fatigue, nervousness, and poor job performance, were blamed on the condition. Most doctors now agree that in most cases, these problems result from other causes. The treatment for functional hypoglycemia may include a diet that contains a planned balance of protein- and carbohydrate-containing foods. Jesse Roth

Hypothalamus, *hy puh THAL uh muhs,* is a small area at the base of the brain. The hypothalamus makes up less than 17 percent of the brain's total volume, but it plays a key role in regulating the body's general level of activity. The hypothalamus helps control the *autonomic nervous system,* part of the nervous system that regulates such automatic body processes as breathing, blood pressure, and heart rate. The hypothalamus also controls the *pituitary gland,* the so-called "master gland" of the *endocrine* (hormone-producing) system.

Certain parts of the hypothalamus regulate body temperature, breathing, sleep, hunger, thirst, urination, sexual drives, and emotions. Other parts produce hormones called *releasing hormones* or *releasing factors.* The releasing hormones travel in the bloodstream to the *anterior lobe* (front part) of the pituitary gland and control secretion of individual pituitary hormones. The pituitary hormones, in turn, affect many of the endocrine glands. These glands secrete hormones that influence growth, sexual development, and the rate the body changes food into energy and living tissue.

In addition to the releasing hormones, the hypothalamus produces the hormones *vasopressin, oxytocin,* and *somatostatin.* These hormones are stored in, and released by, the *posterior lobe* (rear part) of the pituitary gland. Vasopressin, which is also known as *antidiuretic hormone,* reduces the amount of water lost from the body in urine. Oxytocin helps regulate the birth process and milk production in females. Somatostatin slows the secretion of growth hormone. Richard Restak

See also **Brain; Gland; Pituitary gland; Stress.**

Hypothermia, *hy puh THUR mee uh,* is a condition in which the temperature of the human body falls abnormally low, generally below 95 °F (35 °C). The normal human body temperature is 98.6 °F (37 °C). Hypothermia usually results from prolonged exposure to cold.

Hypothermia commonly occurs among individuals who frequent the outdoors, such as hunters and skiers, and among people who accidentally become immersed in cold water, such as when a boat overturns. However, even prolonged exposure to indoor temperatures as high as 65 °F (18 °C) can bring on hypothermia. Such cases occur chiefly among elderly people. Others at a greater than average risk of developing hypothermia include children, people who are ill or injured, and people with poor blood circulation.

Signals of hypothermia include shivering, numbness, loss of vision, drowsiness, dizziness, or confusion. If body temperature falls below 90 °F (32 °C), the victim may lose consciousness. In deep hypothermia—below about 80 °F (27 °C)—abnormal heart action may cause blood flow to slow or stop, leading to death.

A victim of hypothermia should be removed from the cold as soon as possible. Call for medical help immediately. Remove wet clothes and cover the body with dry clothing or blankets. The victim should be warmed slowly. Do not give anything to eat or drink unless the victim is fully conscious. Never give beverages that contain alcohol or caffeine. If the victim becomes unconscious and stops breathing, give artificial respiration. If the pulse stops, give *cardiopulmonary resuscitation* (see **Cardiopulmonary resuscitation**).

Doctors may bring on hypothermia to perform operations in which the circulation of blood must be stopped, such as brain surgery or heart surgery. At normal body temperature, many organs would be permanently damaged if they did not receive oxygen from the blood for more than a few minutes. During hypothermia, the activity of organs and tissues slows down, reducing the need

for oxygen. In deep hypothermia, blood flow may be stopped for more than an hour without damaging body organs. Critically reviewed by the American Red Cross

Hypoxia. See **Anoxia.**

Hyrax, also called *cony* or *coney,* is the name of a family of rabbit-sized animals that resemble guinea pigs. There are seven species of hyraxes. They are found in Africa and southwestern Asia. Hyraxes have short legs, ears, and tails. They have ridges on their feet and broad nails on their toes. They are related to the hoofed animals and probably are most closely related to elephants. Some hyraxes live on rocky hills and others live in trees. The cry of the species that lives in western Africa has been described as "agonized screeching." In addition to hyraxes, certain other rabbitlike animals as well as some rabbits and fishes are called *conies.* See also **Pika.**

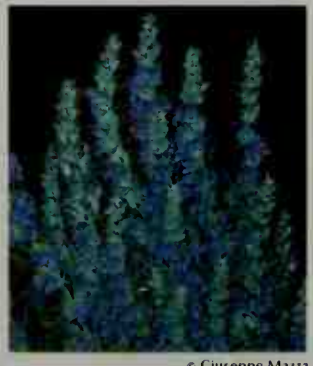
E. R. Degginger

A hyrax is a rabbit-sized animal that resembles a guinea pig. The animal lives in Africa and southwestern Asia.

Scientific classification. Hyraxes belong to the order Hyracoidea. They make up the family Procaviidae. Clyde Jones

Hyssop, *HIHS uhp,* is a bushy evergreen shrub of the mint family. The plant is native to southern Europe and now also grows in many parts of the United States. The hyssop has a square, coarse stem from 1 to 2 feet (30 to 61 centimeters) high. The seeds, flowers, and green parts of the plant have a strong odor and taste. At one time, people used hyssop to season foods. People also used it as a medicine.

Most people now prefer milder flavors and no longer use hyssop as an herb. Gardeners sometimes plant hyssop as a shrub for borders of lawns and gardens.



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Hyssop

Scientific classification. The hyssop belongs to the mint family, Lamiaceae or Labiatae. Its scientific name is *Hyssopus officinalis.* Kenneth A. Nicely

Hysterectomy, *HIHS tuh REHK tuh mee,* is the surgical removal of a woman's *uterus,* the organ in which unborn babies develop. A surgeon removes the uterus through the abdominal wall or through the vagina. After having a hysterectomy, a woman no longer menstruates and cannot become pregnant.

Hysterectomies are most commonly performed to remove *fibroids* (growths of muscle and connective tissue) in the wall of the uterus. These growths may cause pain and excessive menstrual bleeding. In many cases, treatment with hormones can substantially reduce or eliminate uterine fibroids. Small fibroids that do not respond to hormonal therapy can be surgically removed from the uterus. Large fibroids, however, may require a hysterectomy. Other conditions that may require a hysterectomy include endometriosis, pelvic inflammatory disease, cancers that involve the reproductive organs, and an abnormally positioned uterus.

There are three main types of hysterectomies. The *total hysterectomy* removes the entire uterus, including the *cervix* (neck of the uterus). The *subtotal hysterectomy* removes all of the uterus except the cervix. The *radical hysterectomy* removes the uterus and cervix, the upper part of the vagina, surrounding lymphatic tissue, and supporting ligaments. Some hysterectomies include removal of one or both of the fallopian tubes and ovaries. If the surgeon removes both ovaries, the patient will go through the hormonal changes of menopause (see **Menopause**).

Complications of hysterectomies are similar to those of other surgical operations and include fever and infection. In addition, hysterectomies may result in injuries to the rectum and urinary tract. Lynn J. Romrell

For an explanation and diagram of the female reproductive system, see **Reproduction, Human.**

Hysteria, *hihs TIHR ee uh,* is a mental illness in which a person has physical complaints when no physical cause can be found. The ancient Greek physician Hippocrates was one of the first to identify this disorder. He noticed hysteria was common in women and thought it was caused by a displaced uterus. The word *hysteria* comes from *hystera,* the Greek word for *uterus.*

A person with hysteria may have any sort of physical complaint. The person may complain of heart disease, paralysis, sexual problems, stomach pains, vomiting, or weakness of the arms or the legs. In this way, hysteria may imitate any of many physical illnesses. Sometimes, the complaints are so frequent or severe that a doctor may think the patient actually has a physical illness, such as appendicitis. In these cases, the diagnosis of hysteria might not be made until surgery indicates that no physical illness is present.

People are often called hysterical when they are upset, excited, and unable to control their feelings. We often hear of "hysterical weeping" or "hysterical rage." Such outbursts of feeling may have nothing to do with the disorder that psychiatrists call hysteria. In some cases, they occur in normal people. They may also occur in people who have mental illnesses other than hysteria, as well as in those with hysteria.

Psychiatrists usually treat hysteria by using some type of psychotherapy or behavior therapy. Treatment with drugs and hypnosis may also be used along with the psychotherapy. The causes of hysteria are still not known, but the disorder remains more common in women than in men. Nancy C. Andreasen

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